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Rheumatoid Spondylitis: Correlation of Clinical and Roentgenographic Features[1]

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RHEUMATOID (ankylosing) spondylitis predominantly affects males of military age. For this reason it constitutes an important and frequent cause of chronic back disability in soldiers. At the Army Rheumatism Center, Army and Navy General Hospital, 1,084 instances of the disease were observed during a twenty-two-month period; these constituted 18.1 per cent of 6,000 consecutive admissions for rheumatic conditions of all types (1).

Few examples of true "poker back" deformity or "bamboo spine" have been encountered among soldiers; such an occurrence usually led to rejection at the time of induction. The majority of soldiers with rheumatoid spondylitis have been observed during the early or relatively early phases of the disease. This has allowed an unusual opportunity for the study of the early diagnostic features; these features have been outlined elsewhere (2).

It is during the early stages of rheumatoid spondylitis that the best results may be expected from roentgen therapy to the spine, corrective and preventive postural exercises, orthopedic appliances, and other therapeutic measures. To direct such procedures intelligently, it is important to know in each case the degree of extension, the severity, and rate of progression of the disease. Generally such information can be obtained by a correlated study of the clinical and roentgenographic features.

CLINICAL FEATURES

The clinical picture of rheumatoid spondylitis is dependent upon such qualifying factors as the severity of the disease, the degree of spinal extension, the activity of the process at various levels of the spine, the duration of the disease, and the amount of extra-articular soft-tissue involvement. The disease may be mild, moderate, or severe; the intensity of symptoms, rate of progression, and amount of constitutional reaction will vary accordingly. The sacroiliac joints may be involved alone or, at the other extreme, the synovial joints of the entire spine may be affected. The process may be active in one area and "burned out" or quiescent at another level. Associated soft-tissue reaction in the muscles, ligaments, or spinal nerve roots may give rise to symptoms at levels higher than the actual joint involvement. The following is a summary of the clinical features of the disease, especially those which reflect involvement of the various regions of the spine.

Sacroiliac Involvement: Because the disease almost invariably begins in the sacroiliac joints, the symptoms and findings

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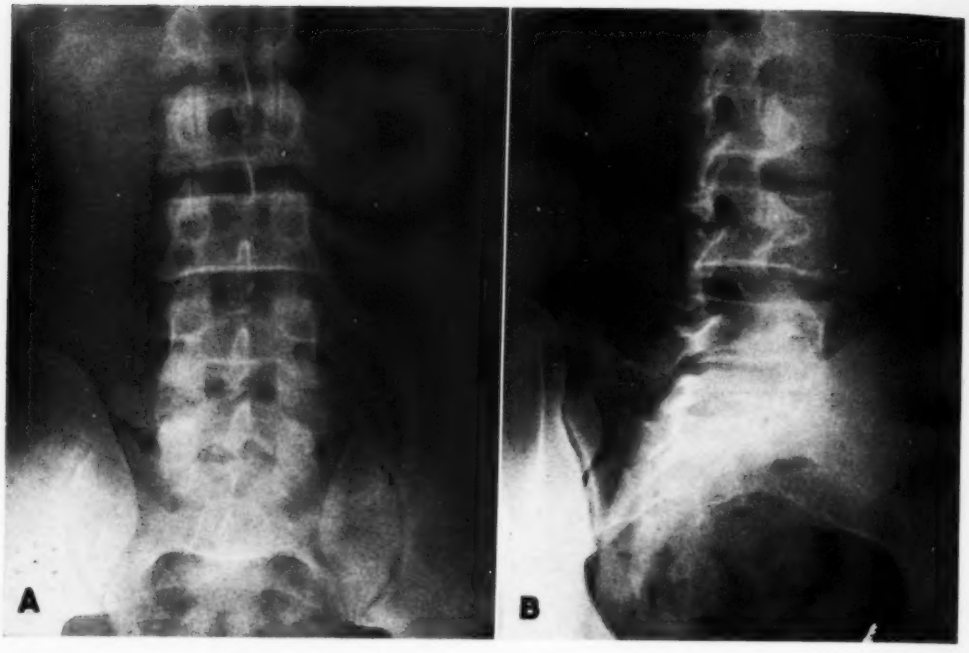

Fig. 1. A. Normal sacroiliac joints. The margins are well defined and the joint space is clear. Note the absence of osteosclerosis. B. Oblique view, showing normal apophyseal joints. Note the apparent absence of the apophyseal joint space between L4 and L5 due to anomalous development; this could be mistaken for ankylosis.

referable to the lower back at onset may be considered as expressions of sacroiliac involvement. In approximately 75 per cent of cases the early symptoms consist of aching and stiffness of the lower back, which qualitatively exhibit the characteristics of "fibrositis," that is, are most pronounced on arising in the morning, are accentuated by physical inactivity and ameliorated by mild exercise, are subject to fluctuations with weather changes, and are relieved temporarily by local heat and salicylates. At first, these symptoms may be intermittent, but after several months or a few years they tend to become persistent. Transient sharp pains or "catches" in the lower back or less well defined complaints, as constant dull discomfort, a soreness, or a tired feeling (accompanied or unaccompanied by symptoms of "fibrositis"), may also indicate sacroiliac involvement. In 10 to 15 per cent of cases sciatica, often intermittent and alternating from side to side, accompanies the phase of sacroiliitis.

The back may be entirely normal on examination. In about 50 per cent of patients with active sacroiliitis, tenderness on percussion may be elicited over one or both sacroiliac joints. Orthopedic tests causing motion in the sacroiliac joints may induce pain. Mild muscle spasm in the lumbar region without true restriction of motion is common.

Lumbar, Thoracic, and Cervical Involvement: When the disease is active in the lumbar, thoracic, and cervical regions, the dominant symptoms consist of pain, aching, stiffness, and restriction of motion in the involved regions. Sciatica is common with lumbar involvement, girdle pains are frequent when the thoracic spine is affected, but cervical radicular pain is rare. Lumbar, thoracic, or cervical involvement may be identified by the presence of the following general signs in the respective regions of the back: limitation of motion; persistent paravertebral muscle spasm; persistent tenderness to percussion over and just lateral to the spinous processes;

pain on forced motion of the spine; paravertebral muscle atrophy. Involvement of the lumbar spine is further characterized by straightening of the normal lordotic curve and by muscle atrophy in the lower portion of the lumbar segment, giving this area an "ironed-out" appearance. Thoracic involvement may be further identified by chest pain on deep inspiration, restricted respiratory excursion, flattened anterior chest, and thoracic kyphosis. A characteristic protruded position of the neck may develop when the cervical spine is involved.

Constitutional Reaction and Laboratory Findings: Weakness, fatigue, anorexia, weight loss, and low-grade fever vary with the severity of the process. Such symptoms generally are not prominent except when the disease is severe or when peripheral arthritis coexists. The erythrocyte sedimentation rate is a fairly consistent gauge of activity in spondylitis and roughly parallels the severity of the disease; however, in 15 to 20 per cent of mild but clinically active cases it may be within normal range. In about one-fourth of the cases a moderate hypochromic anemia exists; severe anemia is rare

ROENTGENOGRAPHIC FEATURES

Alterations in the sacroiliac joints constitute the most diagnostically reliable and almost invariably the earliest roentgenographic findings in rheumatoid spondylitis. The first changes consist of subchondral bony sclerosis and/or spotty demineralization, usually located in the juxta-articular portion of the ilium, particularly at the caudal third of the joint. Later the juxta-articular portion of the sacrum may show similar changes. Involvement is usually bilateral but not always symmetrical in degree. As the process progresses, demineralization and bony condensation cover a wider subcortical zone; but the two processes may not keep pace with each other, one or the other predominating.

The sacroiliac joint at first appears blurred and the margins are indistinct. The joint space may give the false impression of being

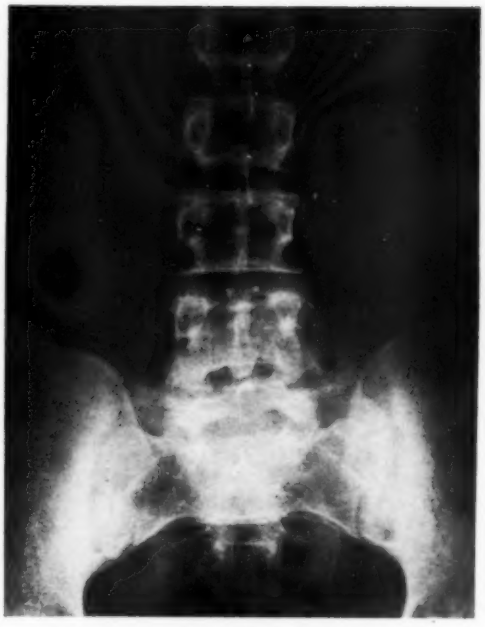

Fig. 2. Typical bilateral sacroiliac involvement. The joint spaces appear widened, due to rarefaction of the articular cortices. Note the juxta-articular osteosclerosis, especially of the ilia.

widened or it may appear narrowed. Varying degrees of joint dissolution may occur; the margins may appear serrated, or there may be irregular mottling (Figs. 1 and 2). With further progression, the joint space is traversed by bony trabeculae; gradually fusion between the sacrum and ilium occurs (Fig. 3). With the development of ankylosis, subchondral sclerosis gradually fades and the bone density of the adjacent ilium and sacrum eventually becomes normal or less than normal. If spotty rarefaction has been pronounced, residues of such change may be evident long after ankylosis is complete (Fig. 4).

Roentgenographic changes in the lumbar, thoracic, and cervical regions are not found as consistently nor are they so diagnostic as the sacroiliac changes. The most common finding consists in calcification of the paravertebral ligaments, especially the anterior longitudinal ligament; this is usually first observed at the lower thoracic and upper lumbar levels. Extensive calcific and later osseous changes in the para-

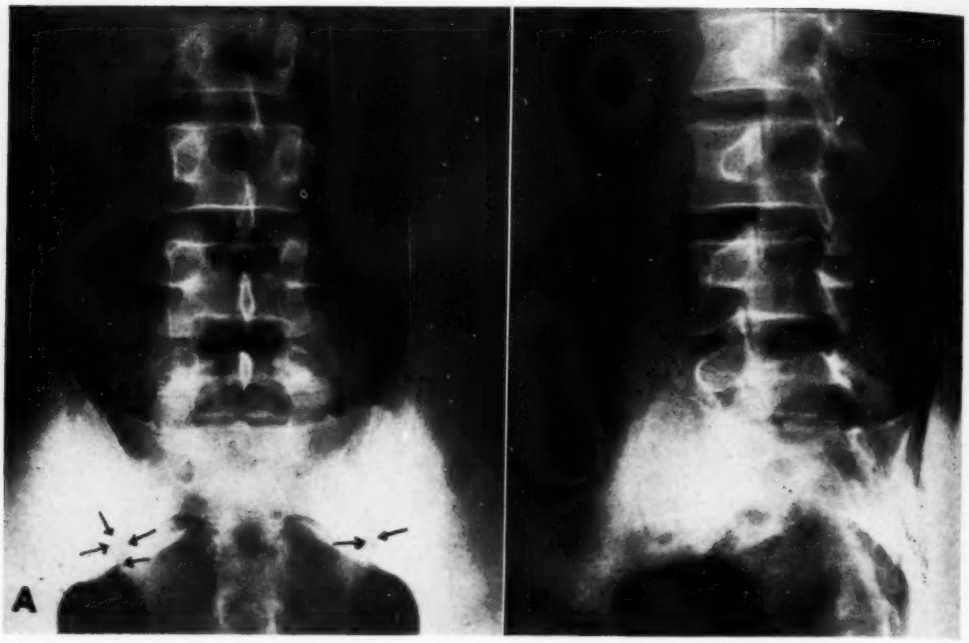

Fig. 3. A. Partial ankylosis of the sacroiliac joints. Mottled rarefaction (arrows) and osteosclerosis are still prominent. B. Oblique view, showing partial ankylosis of the lower portion of the left sacroiliac joint. The lumbar spine was involved clinically; yet the apophyseal joints appear roentgenographically normal. Sacroiliac joint changes are usually advanced long before the apophyseal joints show changes.

TABLE I: CRITERIA FOR SEVERITY OF RHEUMATOID SPONDYLITIS BASED ON CLINICAL APPRAISAL

Severity	Onset	Rate of Progression	Degree of Disability	Constitutional Reaction	Sedimentation Rate	Poker Back Deformity (Progressive Cases)
Mild	Insidious	Slow	Mild	Minimal or absent	Normal or slightly elevated	15 to 25 years
Moderate	Usually insidious	Moderate	Moderate	Not marked but definite	Moderately elevated	5 to 10 years
Severe	Often abrupt	Rapid	Marked	Marked	Markedly elevated	1 to 3 years

vertebral ligaments give rise to the well known advanced and terminal picture of "bamboo spine" (Figs. 4 and 5). Care must be taken not to confuse calcification or ossification of the longitudinal ligaments with hypertrophic spurs; hypertrophic changes usually have a broader base and arise nearer the articular edge of the vertebral body.

Roentgen changes in the apophyseal articulations are inconstant, but when present they are similar to those found in the sacroiliac joints. They consist of juxta-articular rarefaction and/or sclerosis of the facets, irregularity of the articular margins, narrowing of the joint spaces, and eventual ankylosis (Fig. 6). Examination of these articulations is difficult because of the wide variations which exist in the joint planes; often several views with different degrees of obliquity are needed for accurate study. The joint between the fourth and fifth lumbar vertebrae is particularly difficult to demonstrate adequately; frequently one facet has a convex articular surface while the surface of the contiguous facet is concave. The resulting picture may be erroneously interpreted as ankylosis (Fig. 1, B). Even when definite changes are present, only one or a few

scattered apophyseal joints may be roentgenographically involved. Almost always the sacroiliac findings are more definite and of more diagnostic value.

The vertebral bodies frequently show rather square anterior articular margins instead of the normally slightly rounded edges (Fig. 7); in severe cases or late in the disease they may be slightly osteoporotic. Straightening of the normal lordotic curve is common when the lumbar segment is involved.

The intervertebral disks remain normal. Judging from how commonly restriction of chest expansion is observed, the costovertebral joints must be frequently involved; but they rarely show abnormal roentgenographic findings. Calcification of their capsules may occasionally be observed late in the disease.

The symphysis pubis occasionally may be involved; it may appear widened with ragged margins; later, ankylosis may occur. Involvement of the ischial tuberosities is but rarely seen (Fig. 4).

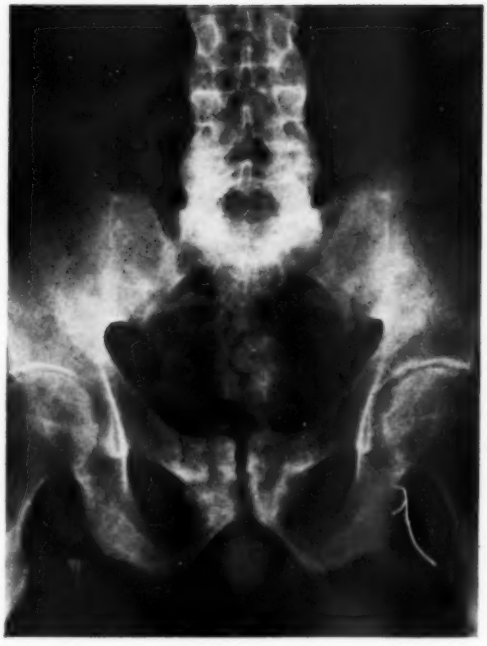

Fig. 4. Complete ankylosis of the sacroiliac joints and extensive ligamentous calcification ("bamboo spine"). Subchondral osteosclerosis is no longer present but residual rarefaction of the articular margins can be identified. This roentgenogram illustrates two unusual findings: (1) changes in the symphysis pubis similar to early sacroiliac changes (Fig. 2) and (2) involvement of the cortices of the ischial tuberosities.

MATERIAL AND METHOD OF STUDY

Fifty soldiers with roentgenographically proved rheumatoid spondylitis were studied. X-ray changes in the sacroiliac joints, characteristic of the disease, were present in every case. The clinical and roentgenographic findings were first studied independently and then correlated while the patients were still under observation in the hospital. Determinations of the severity, duration, and extension of the disease were made on the basis of clinical appraisal.

The severity was gauged by the rapidity of progression of the disease, the amount of constitutional reaction, the degree of disability presented, the erythrocyte sedimentation rate, and the degree of anemia (Table I); 27 cases were classified as mild, 20 as moderate, and 3 as severe.

The duration of the disease was calculated from the onset of back symptoms characteristic of spondylitis. The average duration of symptoms for the series was 4.4 years, the shortest duration being seven months and the longest fifteen years.

The degree of spinal extension was determined by the clinical findings already outlined. There were clinical signs of sacroiliac involvement alone in 9 of the 50 patients; of sacroiliac and lumbar involvement in 21; sacroiliac and thoracic in 2; sacroiliac, lumbar, and thoracic in 13; sacroiliac, lumbar, and cervical in 1; and of all the spinal segments in 4.

Anteroposterior, lateral, and oblique roentgenograms of the lumbar and sacral regions were obtained in each case. Anteroposterior and lateral films of the thoracic spine were made routinely. When evidence of clinical involvement was present in the thoracic spine, oblique roentgenograms were also studied. Oblique views were obtained with a rotation of 45 degrees for the cervical spine, 20 degrees for the thoracic spine, and 35 degrees for the lumbar spine. Additional special projections

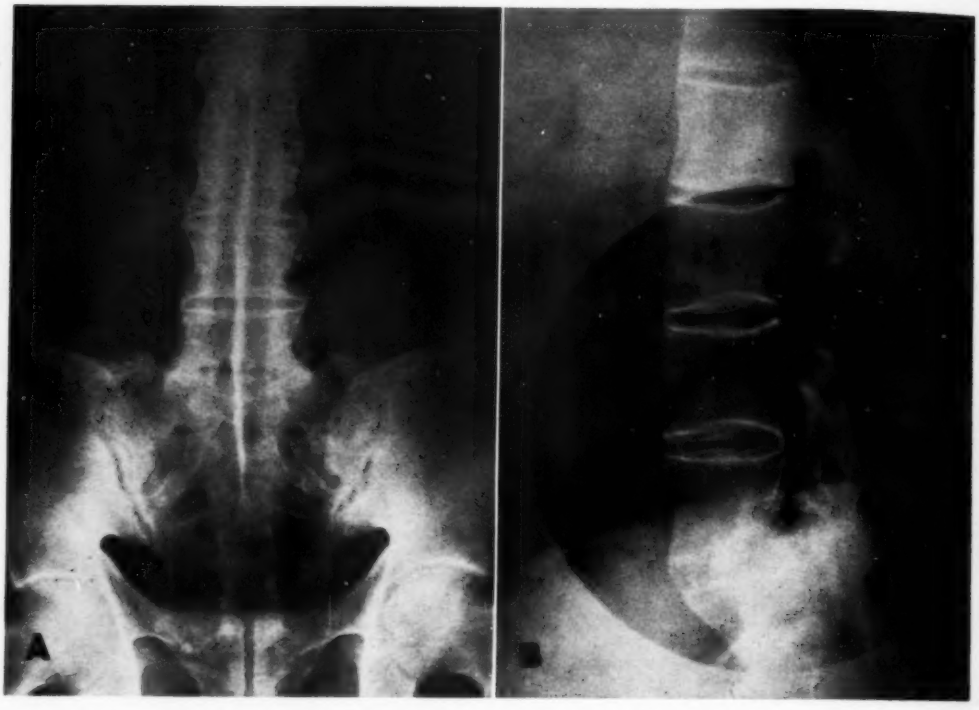

Fig. 5. A. "Bamboo spine" with calcification of ligaments between spinous processes. This roentgenogram is most unusual because the sacroiliac joints, although involved, are not ankylosed. The sacroiliac joints are almost always completely ankylosed when extensive ligamentous calcification is present. B. Lateral view demonstrating calcification and/or ossification of all the spinal ligaments, including the ligamenta flava. The apophyseal joints are ankylosed. The intervertebral disks are well preserved. Note the straight lumbar spine.

were often necessary in order to depict adequately all the lumbar or thoracic apophyseal joints. In most instances we were able to study successfully the sacroiliac and lumbar apophyseal joints on single 10 × 12-inch roentgenograms by rotating the pelvis approximately 25 degrees and by rotating the upper lumbar spine 35 degrees. Although a posteroanterior view may at times depict the sacroiliac joint spaces more clearly, the anteroposterior projection was found entirely satisfactory for routine interpretation.

CORRELATION OF CLINICAL AND ROENTGENOGRAPHIC FINDINGS

Severity: The severity of rheumatoid spondylitis as appraised clinically, was reflected, as a rule, by the qualitative roentgenographic changes in the sacroiliac joints. In general, the amount and the proportions of subchondral sclerosis and rarefaction, and the degree of joint destruction, varied with the severity of the disease. After ankylosis had developed, such correlation was not so evident.

In mild cases the first changes in the sacroiliac joints usually consist of a zone of subchondral iliac sclerosis, haziness of the joint space, and loss of definition of the articular margins. As the disease progresses, sclerosis in the ilium covers a wider zone and the juxta-articular portion of the sacrum shows similar changes (Fig. 8). The articular space becomes progressively more narrowed; gradually, over a period of years, fusion occurs. Spotty juxta-articular rarefaction is rarely conspicuous; often it is entirely absent. Actual joint mottling is usually minimal or absent.

In cases of moderate severity the first changes consist of juxta-articular sclerosis and spotty rarefaction, together with apparent widening and blurring of the articular space. As the disease progresses, the bony sclerosis and the rarefaction become more extensive, but both processes proceed in more or less equal proportions.

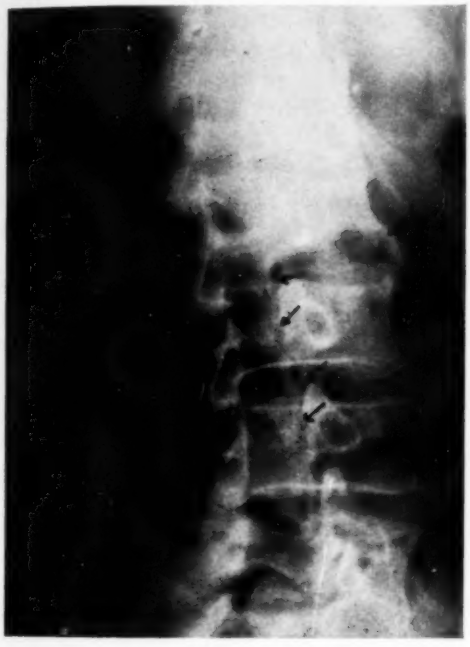

Fig. 6. Apophyseal joint changes. The articular facets of L3 and L4 show mottled rarefaction, and the joint spaces appear irregularly widened (arrow); between the "moth-eaten" areas the joint space appears narrowed. Note that ligamentous calcification is already present (arrow).

The joint space shows mottling with irregularity of its margins (Fig. 9). Gradually, as fusion takes place, osseous fibers can be seen traversing the joint, and its space becomes irregularly narrowed. After ankylosis has developed, sclerosis gradually lessens, but even with complete fusion tell-tale evidence of spotty rarefaction is often observed.

In severe cases the predominant findings in the sacroiliac articulations consist of extensive juxta-articular spotty rarefaction and marked destructive changes in the joint. Mottling of the joint space and

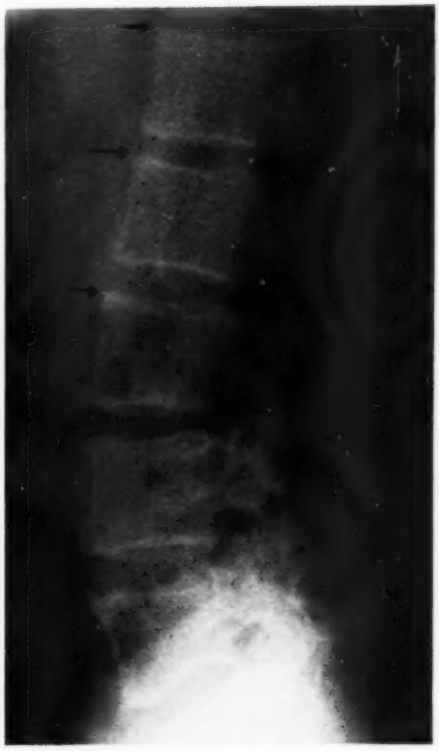

Fig. 7. "Squaring" of the vertebral bodies (arrows), a common finding in rheumatoid spondylitis.

serration of the margins usually are extreme (Fig. 10). Subchondral sclerosis is rarely prominent; it may be entirely absent early in the disease.

Duration: Characteristic x-ray changes in the sacroiliac joints may not develop until months after the onset of persistent low back symptoms (2). We have followed several patients with typical symptoms and physical and laboratory findings of rheumatoid spondylitis, but with normal roentgenograms, who after one, two, or three years have finally shown characteristic sacroiliac lesions. No information, however, was obtained from the present study regarding the time interval between the first clinical and roentgenographic manifestations, since x-ray changes in the sacroiliac joints were necessary criteria for the selection of our cases.

The time necessary for ankylosis of the

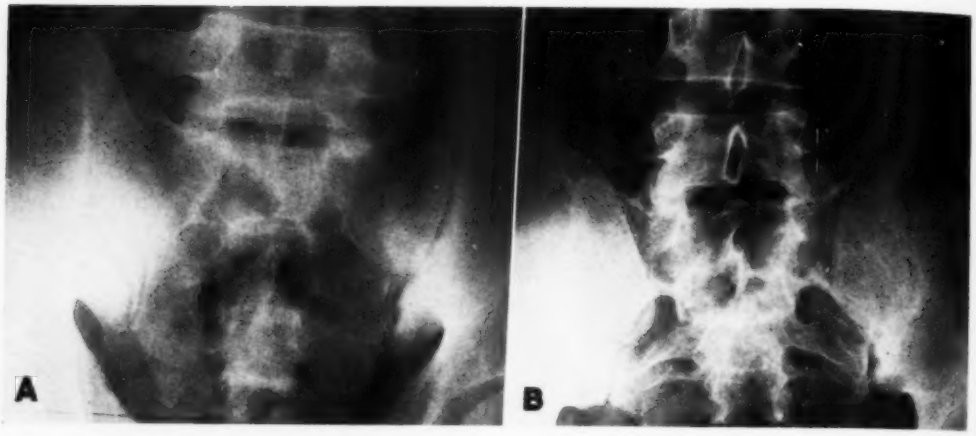

Fig. 8. Characteristic sacroiliac findings in mild rheumatoid spondylitis. The predominant changes consist of juxta-articular osteosclerosis and haziness and narrowing of the joint spaces. Subchondral rarefaction is minimal.

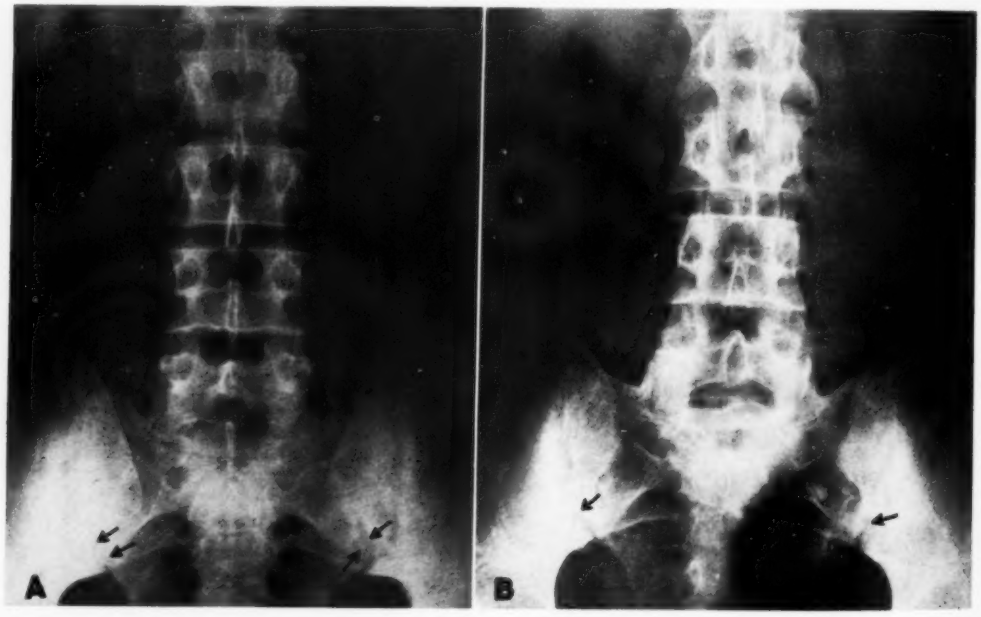

Fig. 9. Sacroiliac joint changes in moderate rheumatoid spondylitis. Note the mottled subchondral rarefaction (arrows); this is rarely conspicuous in mild cases. The joint space appears irregularly widened and the margins are poorly defined. The rarefaction is accompanied by a fairly equal amount of osteosclerosis.

sacroiliac joints to develop was extremely variable and seemingly depended on (*a*) the severity of the disease and (*b*) whether the process was relentlessly progressive or was subject to exacerbations and remissions. Partial ankylosis was observed in 16 of the 50 cases. One case of moderate severity showed partial ankylosis as early as two years after the onset of symptoms, while at the other extreme one mild case, with a history of exacerbations and remissions of back symptoms, failed to show any evidence of fusion after fifteen years. Complete ankylosis was present in 6 cases.

The duration of symptoms in those patients showing ankylosis is charted in Table II.

Calcification or ossification of the paravertebral ligaments was a relatively late manifestation (Table III). Ligamentous calcification was found as early as two years after the onset of symptoms in 2 cases, but several patients with symptoms for over eight years failed to show any evidence of such change. Four patients showed extensive "bambooing"; one had symptoms for six years, but the average duration was nine years.

Only 9 of the 50 cases presented definite roentgenographic changes in the apophyseal joints. These appeared no earlier than ligamentous calcification or, for that matter, than partial ankylosis of the sacroiliac joints; two severe fulminating cases showing extensive apophyseal changes were exceptions (Table III).

Extension: The degree of extension, as determined by clinical findings, was greater than that determined by x-ray abnormalities in approximately two-thirds of the 50 cases. The degree of extension was the same by both examinations in the remaining one-third, and in 9 of these 16 cases both clinical and roentgenographic involvement was restricted to the sacroiliac joints. In 41 patients there were definite clinical signs of involvement above the sacroiliac joints, the lumbar region being affected in 39, the thoracic in 19, and the cervical in 5. Of these 41 patients, approximately one-half (20 patients) failed to show corresponding roentgenographic changes above the sacroiliac joints. In only 2 instances were x-ray alterations found at a level higher than that expected from clinical evaluation; in both of these, early ligamentous calcification was demonstrable in the lower thoracic region.

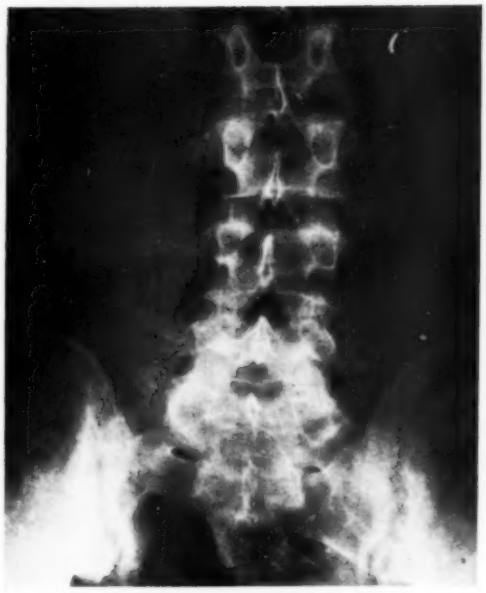

Fig. 10. Sacroiliac joint findings in severe rheumatoid spondylitis. There is marked destruction of the sacroiliac joints. Subchondral rarefaction is much more pronounced than osteosclerosis

TABLE II: ANKYLOSIS OF SACROILIAC JOINTS IN RELATION TO DURATION OF RHEUMATOID SPONDYLITIS

Cases	Average Duration of Symptoms (years)	Partial Ankylosis			Complete Ankylosis		
		No. of Cases	Duration of Symptoms (years)		No. of Cases	Duration of Symptoms (years)	
			Average	Shortest		Average	Shortest
Mild 27 cases	4.8 (1 to 15)	6	8.2	4.0	0	0	0
Moderate 20 cases	4.1 (1 to 9)	10	4.7	2.0	6	7.8	5.0
Severe 3 cases	0.9 (0.58 to 1.25)	0	0	0	0	0	0

The most common roentgenographic abnormality found in the lumbar, thoracic, and cervical regions was calcification of vertebral ligaments. Of the 21 patients with x-ray findings above the sacroiliac joints, 19 had ligamentous calcification. In contrast, only 9 patients had demonstrable alterations in the apophyseal joints, and in 7 of these ligamentous calcification coexisted. Undoubtedly, if our patients had been studied later in the course of the disease, apophyseal lesions would have been more common and more extensive. But

TABLE III: LIGAMENTOUS CALCIFICATION AND APOPHYSEAL JOINT CHANGES IN RELATION TO DURATION OF RHEUMATOID SPONDYLITIS

Cases	Average Duration of Symptoms (years)	Ligamentous Calcification			Apophyseal Joint Alterations		
		No. of Cases	Duration of Symptoms (years)		No. of Cases	Duration of Symptoms (years)	
			Average	Shortest		Average	Shortest
Mild 27 cases	4.8 (1 to 15)	7	6.6	2.0	2	8.0	4.0
Moderate 20 cases	4.1 (1 to 9)	14	5.0	2.0	5	6.0	3.0
Severe 3 cases	0.91 (0.58 to 1.25)	0	0	0	2	0.75	0.58

even when rheumatoid spondylitis is moderately advanced, x-ray alterations in these joints are inconstant and are of less value than ligamentous calcification in judging roentgenographic extension. We have obtained no information from detailed studies of the apophyseal joints which was not already obvious from physical examination.

DISCUSSION

In attempting to explain the various musculoskeletal symptoms associated with rheumatoid arthritis, it is well to keep in mind that, whereas the articular structures are principally involved, similar pathologic changes occur in extra-articular structures such as muscles, tendons, fasciae, and bursae. There is abundant clinical evidence, and some pathologic proof (3, 4), that the lesions of rheumatoid arthritis are widespread throughout the musculoskeletal system, such changes often being distant from sites of joint involvement. Of particular clinical importance are those symptoms resulting from associated involvement of the muscles and periarticular fibrous structures.

Although rheumatoid spondylitis has certain peculiarities which are not shared by peripheral rheumatoid arthritis, such as a predilection for males and a tendency toward calcification of ligaments, the disease is probably but the spinal variant of rheumatoid arthritis. The best evidence for this connection is that typical peripheral rheumatoid arthritis coexists in 25 to 30 per cent of cases. Biopsy specimens taken from the joints in such cases show microscopic changes identical with those found in peripheral rheumatoid arthritis without spondylitis (5). Pathologic specimens taken from apophyseal joints during active phases of spondylitis reveal microscopic findings similar to those seen in peripheral rheumatoid arthritis (6, 7).

The principal pathologic lesions in rheumatoid spondylitis consist of synovitis, chondritis, and juxta-articular osteitis of the sacroiliac, apophyseal, and costovertebral joints; but associated changes, such as paravertebral ligamentitis, periarticular capsulitis, and intramuscular fibrositis, probably coexist. Calcification of ligaments and joint capsules probably serves as indirect evidence of ligamentitis and capsulitis (8, 9). Pathologic evidence of inflammatory reactions in the erector spinae muscles is lacking, but inflammatory changes have been found in the muscles in conjunction with peripheral rheumatoid arthritis (3). The aching, stiffness, and local tenderness of the back muscles, so prominent in spondylitis, certainly suggest muscular involvement. It is difficult to explain the intermittent diffuse low back symptoms, unassociated with localizing signs of lumbar spinal involvement, which so commonly accompany the phase of sacroiliitis without admitting the existence of secondary changes in the muscles and ligaments.

As in rheumatoid arthritis involving peripheral joints, intra-articular roentgenographic abnormalities occurring in the spinal joints result from destruction of articular cartilage and from alterations in subchondral bone. When the pathologic process is restricted to the synovial membrane, roentgenograms are negative. It may take months or years for the develop-

ment of sufficient cartilaginous or osseous change to be recorded on roentgenograms; though pathologically involved, some joints may never show positive x-ray findings. These considerations explain the time interval which exists between the development of localizing physical signs and the appearance of roentgenographic changes.

From the present study, it is apparent that involvement clinically is often one or two spinal segments higher than that noted roentgenographically. If x-ray therapy to the spine is to be given for this disease, it is obvious that the regions selected for treatment should be chosen on the basis of clinical rather than roentgenographic involvement.

SUMMARY AND CONCLUSIONS

Rheumatoid spondylitis has been found to be a frequent and important cause of chronic back disability in soldiers; 1,084 soldiers with this disease were admitted to an Army Rheumatism Center during a twenty-two-month period.

Fifty cases of rheumatoid spondylitis were studied clinically and roentgenographically, and an attempt was made to correlate the findings.

The severity of the disease, as appraised clinically, was usually reflected by the character of the sacroiliac changes. In mild cases, juxta-articular sclerosis and narrowing of the joint were the predominant features; subchondral rarefaction was minimal and joint mottling was not prominent. In moderate cases, observed before ankylosis, subchondral rarefaction and sclerosis were present in fairly equal proportions, and mottling of the joint was definite. In severe cases, juxta-articular rarefaction and joint destruction were extreme; subchondral sclerosis was not so conspicuous.

X-ray changes in the sacroiliac joints may not develop for months or for two to three years after the onset of back symptoms characteristic of rheumatoid spondylitis. The time necessary for ankylosis of the sacroiliac joints to develop was variable and seemingly depended upon the severity of the disease and whether the process was relentlessly progressive or subject to exacerbations and remissions.

Calcification of the paravertebral ligaments was a relatively late manifestation but constituted the most common x-ray finding above the sacroiliac joints. Definite roentgenographic changes in the apophyseal joints were inconstant even when the disease was moderately advanced; apophyseal alterations, as a rule, occurred no earlier than ligamentous calcification or partial ankylosis of the sacroiliac joints.

In approximately two-thirds of the 50 cases studied, the degree of extension as determined by clinical findings was greater than that determined by roentgenographic changes.

The general clinical and roentgenographic features of the disease have been discussed. An attempt has been made to explain certain symptoms of rheumatoid spondylitis on the basis of associated changes in the extra-articular soft tissues.

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Giant-Cell Tumors of Soft-Tissue Origin[1]

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THE BENIGN giant-cell tumor is the most common neoplasm occurring in the periarticular tissues, ligaments, tendons, and bursae located near joints. Jaffe, Lichtenstein, and Sutro, in 1941, added 55 cases to a total of 339 previously reported in the literature. The tumor is variously known as xanthoma, myeloplaxoma, endothelioma, myeloma, and granulation-tissue tumor. The other benign tumors occurring in the same areas are chondroma, osteochondroma, ganglioma, lipoma, fibroma, and angioma. Malignant neoplasms are rare and include chondrosarcoma, fibrosarcoma, and the so-called malignant synovioma. These latter are subdivided into spindle-cell, alveolar, and anaplastic types.

INCIDENCE AND LOCATIONS

A good cross section of the relative incidence of both benign and malignant tumors is given by Geschickter and Lewis in a report from the Surgical Pathological Laboratory of Johns Hopkins University, as follows:

	Cases
Giant cell tumor of tendon sheath origin	50
Ganglioma	40
Osteochondroma	7
Fibroma	4
Lipoma	2
Angioma	0
Chondrosarcoma	2
Sarcoma (fascial type in tendons and sheaths)	5

Charache found 5 giant-cell tumors of the tendon sheaths in a series of 16,500 hospital admissions and 157,000 clinic admissions but, oddly, all were seen in 1939–40. Schreiner and Wehr, in 1934, reported that among a total of 11,212 malignant and 7,110 benign tumors seen in their clinic, of which 265 (128 malignant and 137 benign) occurred in the hand, there were 7 giant-cell tumors of the tendon sheaths.

Galloway, Broders and Ghormley, of the Mayo Clinic, in 1940 reported 70 cases showing 88 soft-tissue giant-cell tumors: 82 occurred in tendon sheaths and 6 in the synovia of the knee joint. Of those in the tendon sheaths, 64 were in the upper extremity. Of that number, 54 involved the fingers and 38 of the 54 were in the fingers of the right hand. Of the 88 tumors, 60 occurred on the right extremities. The middle finger was most commonly involved, and the most common site was the distal phalanx. Of 68 tumors of this series, 28 were on flexor and 37 on extensor surfaces; the remainder were not classified. In their review of the literature, Galloway and his associates found that the single most common site was the flexor surface of the right index finger. These statistics are typical of all reported in the literature except those of Lewis, who, among 50 cases, found 32 involving tendons at the metacarpophalangeal or interphalangeal joints on the flexor side.

The giant-cell tumors arising in synovia have a predilection for the knee. Galloway *et al.* found 43 cases in the literature, of which 37 were in the knee, about equally distributed as to right and left sides; 3 were in the ankle, and 3 in the tarsal joints. Their own 6 cases all involved the knee.

AGE AND SEX

Most authors place the peak of incidence in the third and fourth decades. In Galloway's report, the sex was given in 236 cases; 55 per cent were in females. The average age of 119 women was thirty-seven years, and of 101 men, thirty-eight years.

[1] From the Department of Radiology, the Lahey Clinic, Boston, Mass. Read by title at the Thirty-first Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov. 9–10, 1945.

Ages ranged from five to eighty-two years. The peak of incidence was in the third decade.

SYMPTOMS AND SIGNS

The usual complaint is the occurrence of a slowly growing mass which causes mechanical difficulty with a joint or creates a fear of malignant growth. Galloway found that in 133 cases reported in the literature in which the tendon sheath was involved, symptoms had been present for an average of five years and four months; in 23 synovial tumors, the average duration was three years and eleven months before treatment or advice was sought.

The average tumor of tendon sheath type is a small mass 1.5 to 2.0 cm. in diameter, which can be palpated subcutaneously in the vicinity of a tendon and is not fixed to the skin. The motion of the tendon is not affected except by mechanical block due to the bulk of the tumor. In the synovial type, particularly when the knee is involved, the symptoms are said by Galloway to be similar to those of internal derangement of the knee. Jaffe *et al.* stated that these synovial lesions of the knee produce a serosanguineous fluid, the presence of which should make one think of a giant-cell lesion. Roentgenologic examination in the case of the larger diffuse tumors may show pressure erosion of bone; the smaller ones produce no bone or joint changes.

DIFFERENTIAL DIAGNOSIS

Mason and Woolston, who reviewed the literature in 1927, stated that giant-cell tumors of the tendon sheaths are among the most common of all tumors occurring in the fingers and should be differentiated from the following conditions, in the order given:

(*a*) Chondroma: Harder than a giant-cell tumor.
(*b*) Lipoma: Softer than a giant-cell tumor.
(*c*) Carcinoma: Skin involved and fixed.
(*d*) Osteoma: Fixed to bone.
(*e*) Ganglioma: More commonly seen on dorsum of wrist.
(*f*) Tuberculosis: No differential criteria given.
(*g*) Fibroma: Very rare.
(*h*) Tumors of tendons: Exceedingly rare.

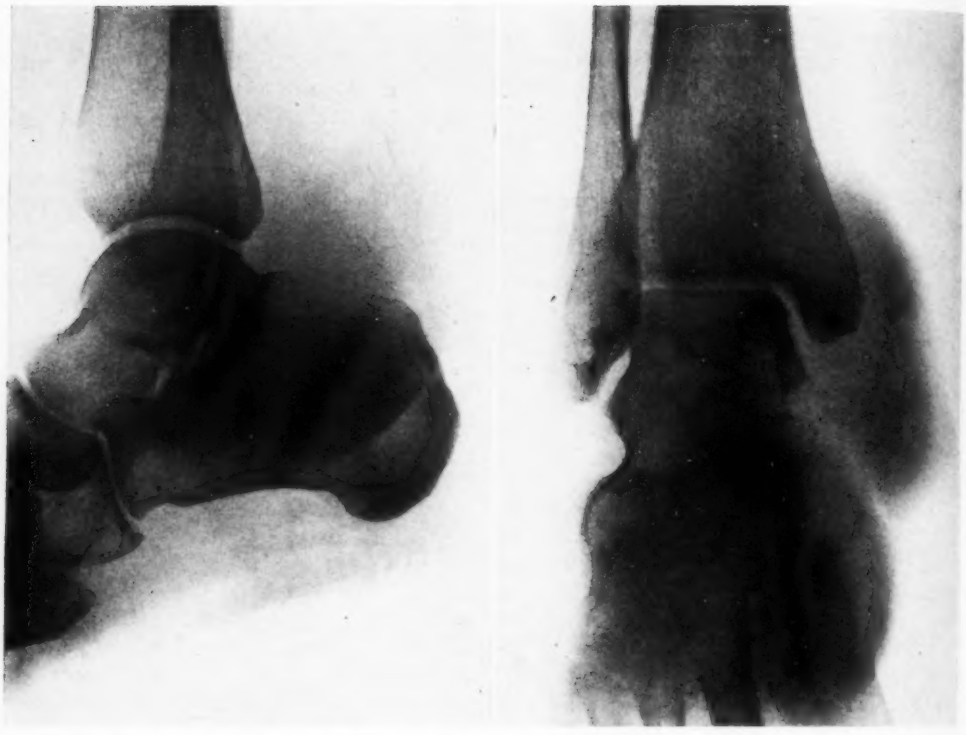
PATHOLOGY

The tendon-sheath tumors are firm, lobulated, grayish-white masses, showing streaks or areas of yellow and yellow-brown. They have a fibrous capsule and do not invade the tendon or the tendon-sheath space. Nor do they invade bone, though they may cause pressure erosion if they reach sufficient size. The majority are small, as mentioned above, but they may attain a diameter of 5 cm. even on a finger or toe. The synovial type may be circumscribed, as in the tendon sheaths, pedunculated, or diffuse. None has been known to metastasize.

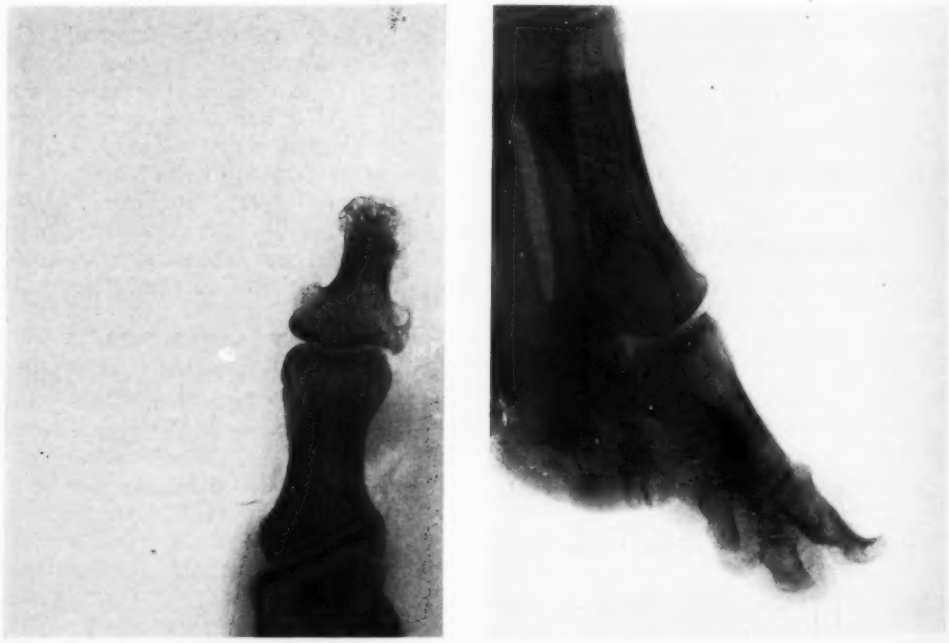
Microscopically, the tumors are characterized by the presence of giant cells, hemosiderin, macrophages, and foam cells in varying numbers. The presence of hemosiderin and lipoid accounts for the yellow and brown color patterns. The type cell seems to be a large polyhedral cell. There may be varying numbers of spaces lined by synovial-like cells, containing varying amounts of lipoid material, and/or nests of hemosiderin, macrophages, small giant cells, and foam cells. Galloway *et al.* state that the color in these tumors is due to the presence of carotin and xanthophyll and not to the cholesterols.

TREATMENT AND PROGNOSIS

All writers are agreed that the treatment of choice is surgical excision. Rarely this may be impossible, as in the case reported by Cristol and Gill, in which two previous excisions had failed to remove the lesion in the tarsal joints and it became necessary to amputate the foot and ankle. The amputated specimen showed xanthomatous infiltration throughout the foot. Galloway *et al.* reported surgical excision in 69 of their 70 cases (88 tumors), the seventieth



Figs. 1 and 2. Case I: Roentgenograms showing a soft-tissue mass but no bone changes.



Figs. 3 and 4. Case II: Giant-cell tumor arising in the tendon sheath; no bone changes.

patient coming to the Mayo Clinic immediately after excision. Eight patients had additional radiation therapy. One, with a diffuse synovial tumor, was subjected to total synovectomy. Recurrence took place in 9 cases, and 5 patients had a second excision, while 1 patient had excision plus radiation. Of the 70 patients, 12 had recurrent lesions on admission to the Mayo Clinic; 10 had one recurrence and 2 had two recurrences. The interval between the original excision and recurrence varied from six days (recurrence?) to eleven years.

Freedman and Ginzler reported promising results with x-ray therapy in 2 recurrent lesions of the diffuse synovial type.

CASE REPORTS

CASE I: A 52-year-old housewife with hypertension, adenoma of the thyroid, and a recent history of cerebral accident had a tumor approximately 6 × 10 cm. in the posteromedial aspect of the right foot and ankle. It had been present for three years and was gradually enlarging. It felt cystic, and the overlying skin had a bluish tinge. It was apparently attached to the internal malleolus. Roentgenograms showed no bone changes, but merely differentiated a soft-tissue mass (see Figs. 1 and 2). On May 20, 1944, a lobulated, dark brown, semicystic mass was excised which extended down the compartment of the medial plantar nerve and up the compartment of the posterior tibial nerve. It was impossible to clean out the tumor from the medial and plantar aspects of the os calcaneus and the adjacent tarsal bones. Microscopic examination showed a giant-cell tumor of tendon sheath origin. Unfortunately, the only follow-up was on July 17, 1944; the wound was then incompletely healed and there was considerable edema of the foot and leg.

CASE II: A 39-year-old hairdresser, admitted for menorrhagia in 1937, complained also of swelling of the left great toe, of unknown duration. Physical examination showed a tender, firm, discrete mass, 2 × 3 cm., attached to deep tissue. Roentgenograms showed no bone changes (Figs. 3 and 4). At operation, in April 1939, a lobulated, discrete tumor attached to the plantar aspect of the proximal phalanx, embracing the long flexor tendon and extending back into the foot, was completely removed. The microscopic diagnosis was giant-cell tumor of tendon-sheath origin with a focus of slowly growing *fibrosarcoma*. The latest information was obtained in August 1942 in a letter from the patient, in which she said there were no symptoms and no evidence of recurrence.

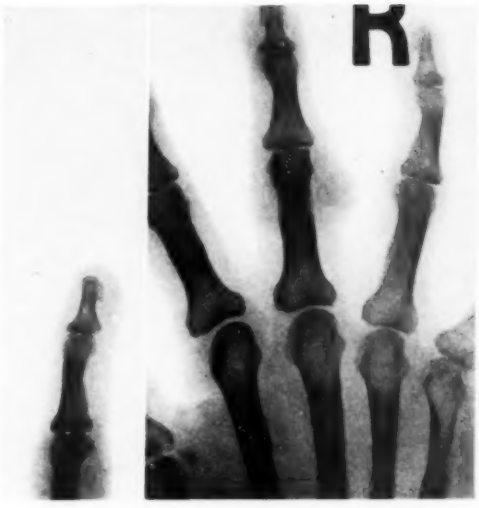


Fig. 5. Case III: Roentgenograms showing a soft-tissue mass on the medial aspect of the proximal phalanx, of the middle finger with pressure erosion of the bone.

CASE III: A 59-year-old housewife was admitted in 1937 complaining of a lump in the middle finger, which she first noticed in 1934. It seemed to have appeared suddenly and enlarged slowly. Physical examination showed several small cystic masses on either side of the proximal interphalangeal joint. Roentgenograms showed a soft-tissue mass on the medial aspect of the proximal phalanx, with pressure erosion of the phalanx (Fig. 5). At operation, in October 1937, a mass 2 × 1.5 × 1.5 cm. was removed from the lateral aspect, and a mass 1 cm. in diameter from the medial aspect of the proximal phalanx of the middle finger. The larger mass was partly fibrotic and partly cystic, the cysts containing gelatinous material. The smaller mass was smooth and firmly nodular. It was light gray in color with foci of brownish-gray material. Both were adherent to the *extensor* tendon. The diagnosis on microscopic examination was giant-cell tumor of the tendon sheath. One year later, when the patient was last seen, there was no recurrence.

CASE IV: A 59-year-old housewife presented as an incidental problem, in September 1933, a discrete, firm, sharply demarcated, slightly cyanotic, non-tender mass on the dorsum of the left index finger. The exact length of time it had been present was not known. A roentgenogram showed a soft-tissue mass projecting posteriorly and radially from the middle phalanx. There were no bone changes. A mass 2.5 cm. in length was excised, and the pathologic report was benign giant-cell tumor. In March 1936 there was a recurrence, and a mass approximately 1.0 cm. in diameter was removed. There has been no subsequent recurrence.

DISCUSSION

In contrast to the unanimity of agreement as to the clinical course and treatment of these tumors are the divergent theories as to their cause. Of contributors to the modern literature, King, Morton, Ragins, and Shively, as well as many others, believe that these are true tumors arising from cells of the synovial membrane lining the tendon sheaths, joints, and adjacent bursae. King believes that the cells lying at the junction of synovia and cartilage show transition from the one type of tissue to the other, and that these cells become the growth center for the tumors under discussion. In this transition zone, the synovial cells become widely separated in the stroma, and King calls them pseudocartilage. From them is derived the cartilage found in synovial membrane. This, he believes, also explains the presence of chondromas in tendon sheaths. He regards the spaces occurring in these giant-cell growths, which are lined by tumor cells, as an attempt by the tumor to form synovial spaces. The similarity in appearance between the papillary projections which occur in tendon-sheath giant-cell tumor and those found in the synovial tumors of joints is cited as additional proof for his thesis. King also noted that some of the vascular spaces in the tumors are lined by tumor cells and hence are angiomatous. He considers the angiomatous tumors of tendon sheaths to be vascular synovial growths. Another point of interest he makes is that the villi occurring in chronic inflammation of tendon sheaths and those occurring in tumors of the tendon sheaths are covered by the same type of synovial cell. King does not postulate cell rests.

Geschickter and Copeland, and Lewis, also consider these lesions true tumors, but believe they arise from cell rests at the site of tendon insertions to bone. They call these cell rests precartilage and hold that, since these precartilaginous cells are capable of producing both bone and cartilage, they may constitute a source, also, of osteochondroma and chondrosarcoma. In the opinion of these investigators, the ability of giant cells to proliferate in the embryo during resorption of calcified cartilage, to phagocytize lipoids, and to produce xanthomatous cells, is a satisfactory explanation of the causation of soft-tissue giant-cell tumors. A further argument for postulating the presence of cell rests is that those portions of tendons, ligaments, and joints not related histogenetically to skeletal tissue rarely show tumors of the giant-cell type. Moreover, these giant-cell tumors of soft tissue are similar to skeletal tumors of the same name. Geschickter and his co-workers also included the ganglion of tendon sheaths in this group of tumors. The ganglion, they believe, represents mucoid degeneration of cartilage.

Another argument advanced by these authors is that the tendon-sheath giant-cell tumors arise in relation to sesamoids. This was also noted by Pfitzer. Geschickter *et al.* call attention to the similarity of the soft-tissue giant-cell tumors to those of the patella. Incidentally, the 16 reported cases of giant-cell tumor of the patella collected by Levine in 1943 all had a history of direct trauma to the patella. Levine gave as his opinion that the patellar giant-cell tumors were granulomas resulting from organization of hematomas in the marrow.

Jaffe, Lichtenstein, and Sutro are of the opinion that the giant-cell tumors of soft-tissue origin are related histogenetically to the hemorrhagic villous synovitis of joints, tendons, and bursae, and that the difference in both gross appearance and microscopic picture can be accounted for by the fact that the lesion in the tendon sheath is manifested much later in its course and has undergone much fibrous involution. The gross appearance is also modified by confinement in the small area occupied by the tendon sheath. It is interesting at this point to recall that King noted the similarity of tendon-sheath tumors to those of the synovia of joints and also the similarity of the synovial-like cells lining the villi to those in chronic inflammation of tendon sheaths. Jaffe and his associates, however,

believe that the giant-cell tumors of soft tissue and hemorrhagic villous synovitis are not neoplastic but represent an inflammatory response to an as yet unknown agent.

Mason and Woolston, who reviewed the literature and added 8 cases of soft-tissue giant-cell tumor, found that 6 of their 8 patients gave a definite history of repeated trauma to the site of the lesion. They, therefore, also believed that these tumors represent an inflammatory response and are not neoplastic. In one of their cases the tumor arose in the palmar fascia, and one joint lesion came from fibrous tissue; in a case cited from Seyler the tumor arose from the perineurium of the ulnar nerve. These cases are hard to explain on the basis of cartilaginous rests or the presence of sesamoids.

Galloway, Broders, and Ghormley, in the excellent review quoted above, disputed the sesamoid theory of origin by stating that half of their total of 88 tumors occurred in extensor tendon sheaths where sesamoids do not exist. They agree with Thannhauser and Magendantz that these lesions are primary essential xanthomas. They believe that two factors are involved: first, a pre-existing disturbance of lipoid metabolism; second, either trauma or infection at the site of the local lesion. Of 12 cases in which blood lipoid studies were carried out at the Mayo Clinic, 6 showed elevation of the total blood lipoids; 5 showed an increased and 3 a decreased ratio between cholesterol and its esters. In 44 per cent of the 70 cases studied by Galloway *et al.* there was a history of specific trauma to the part involved; 20 per cent had arthritis; 7 per cent had both trauma and infection; and 55 per cent had either infection or trauma.

Bisgard, in 1937, while experimenting with growth repair in bone defects produced by excision of a segment of the radius in rabbits, inadvertently dislocated the distal ulnar epiphysis in 12 legs. In 5 of these spontaneous reduction occurred; the remaining 7 showed growth disturbances manifested by retardation of length and deviation of the shaft away from its normal long axis. In addition, tumors developed: in 2 cases simple osteomas and in 3 cases osteochondromas similar to those seen in man. In the last 2 cases the tumors were soft and friable, reddish-brown, circumscribed, and extending to the epiphyseal cartilage (such tumors in man arise in the epiphysis and not the metaphysis, but only after closure of the epiphyseal line). Roentgenologically, and in their gross and microscopic appearance, these 2 tumors were giant-cell tumors. Bisgard, therefore, believes that giant-cell tumors are related to trauma with hemorrhage.

SUMMARY

1. Soft-tissue giant-cell tumors are not rare. They occur widely, wherever there are joints and tendons. They are most frequently seen in the hand, where they are among the most common of tumors.

2. Surgery, with complete excision, is the treatment of choice. Recurrence is likely to follow incomplete removal, especially in the joints.

3. The tumors have not been known to metastasize and do not invade bone, though they cause erosion of bone by pressure.

4. The more recent writers regard these tumors as of traumatic rather than of neoplastic origin. It seems probable that there is a relationship between (1) giant-cell tumors of soft-tissue origin, (2) chronic inflammation of tendon sheaths, and (3) the so-called hemorrhagic villous synovitis.

5. One of the writer's cases showed a focus of slowly growing fibrosarcoma.

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Osteohydatidosis: Its Radiological Features[1]

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OSSEOUS INVOLVEMENT occurs in only a small proportion of cases of echinococcus infestation, probably about 1 per cent. The six-hooked embryo of the *Taenia echinococcus* reaches the bone by way of the arterial circulation, establishing itself in the interstices of the spongy tissue, usually in the most highly vascularized areas, as in the epiphyseal ends of the long bones. Microvesicles replace the medullary tissue, molding themselves to the contours of the bony spaces and diffusely infiltrating the bone. Since there is no intermixture of connective-tissue elements, no adventitious membrane is formed, as in other parts of the body. Hydatid disease of the bone thus differs in two respects from hydatid disease elsewhere, namely (*a*) exogenous vesiculation and (*b*) absence of an adventitious membrane. "Hydatid cyst" of the bone is, therefore, a misnomer, not in accord with the facts, and should be replaced by the term osteohydatidosis.

In the lungs and other viscera, the characteristic feature of hydatid disease is a large cyst containing the hydatid fluid and the germinal layer, surrounded by a fibrous capsule representing the reaction of the adjacent tissues. When the parasite lodges in bone, however, it is unable, because of the resistance of the tissue, to follow its usual mode of development and therefore assumes an exogenous type of vesiculation. The microvesicles arising in the walls of the primary vesicle advance eccentrically, taking on an independent existence and producing "granddaughter vesicles," which invade the bony tissue. This process, so far as the bone is concerned, is in the nature of a mechanical effect and may continue silently for years without exciting any reaction such as an osteitis. Only later is there an associated necrosis of toxic or ischemic origin.

[1] Accepted for publication in May 1946.

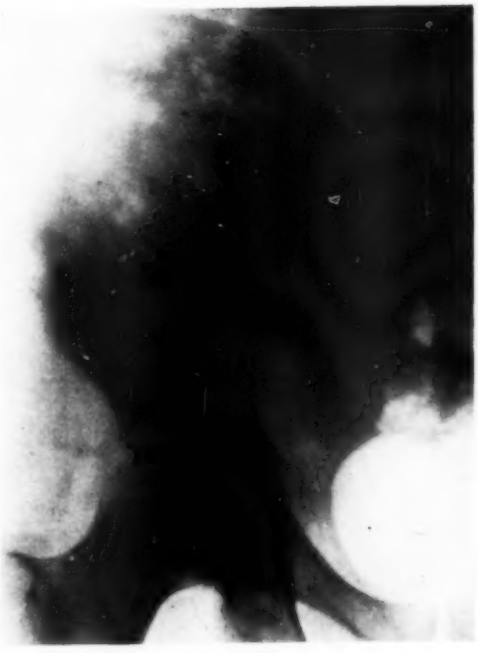

Fig. 1. Hydatidosis of the innominate bone. This is a relatively frequent location. Rarefaction of the bone predominates.

As the bone is infiltrated, destroyed, and replaced by the exogenous hydatids (Fig. 1), the integrity of the cortex is not at first interrupted and the general configuration of the bone is unchanged. Eventually, however, with progressive invasion, the cortex also gives way, and extra-osseous signs of hydatidosis become evident. Among the most significant of these is the ossifluent abscess of hydatid origin. Once the periosteum is penetrated, the vesicles are no longer imprisoned within the confines of the bone, and growth assumes a more rapid pace. The adjacent tissues react in an attempt at encystment, and a common adventitious membrane is formed, enclosing numerous vesicles of various size. The abscess thus formed has no germinal layer, which should always suggest its

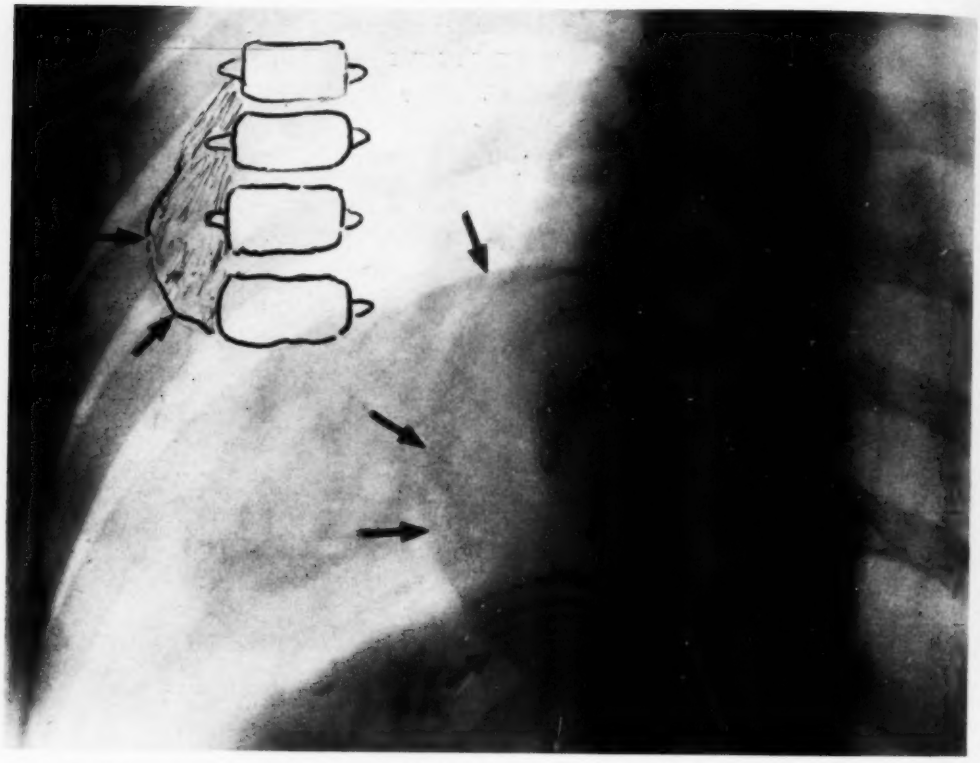

Fig. 2. Extra-osseous hydatidosis. Hydatid abscess with softening of the bone (ossifluent abscess). There are no radiographic signs permitting differentiation from a tuberculous abscess, but the vertebral lesion is characteristic of hydatidosis.

bony origin. Growth is slow and may continue over a period of years.

Just as there is an absence of clinical signs of osteohydatidosis over a long period, so there is an absence of radiologic manifestations of the bony changes. In general, the development may be said to comprise two stages. In the *first stage*, which is that of microvesicular infiltration of the osseous tissues, the vesicles enlarge, the areolar pattern of the bone is destroyed, and there may appear on the film rounded cyst-like spaces limited by thin trabeculae, producing the appearance of a bunch of grapes (Leborgne).

The *second stage*, occurring late in the course of the disease, is one of engrafted infection, with the development of an inflammatory osteitis, which is absent in the earlier stage. Calcification of the trabeculae confirms the presence of a secondary infection, and the resulting hyperostosis and condensation process may cause the disappearance of the grape-like shadows seen in the earlier stage.

The reaction of the bone, meantime, progresses beyond the site of parasitic involvement, encroaching upon sound tissue, which is slowly and insensibly broken down. There is no sharp demarcation between the normal and diseased areas of bone (Fig. 1), which, as will be shown later, is of importance for the differential diagnosis. As a rule, the infection associated with osteohydatidosis is not of the rapidly progressive type but is characterized by a gradual evolution. As a result of this prolonged irritation, hyperostosis is usually predominant over osteolysis.

The periosteum does not react to the hydatid process and presents a normal appearance unless involved by the secon-

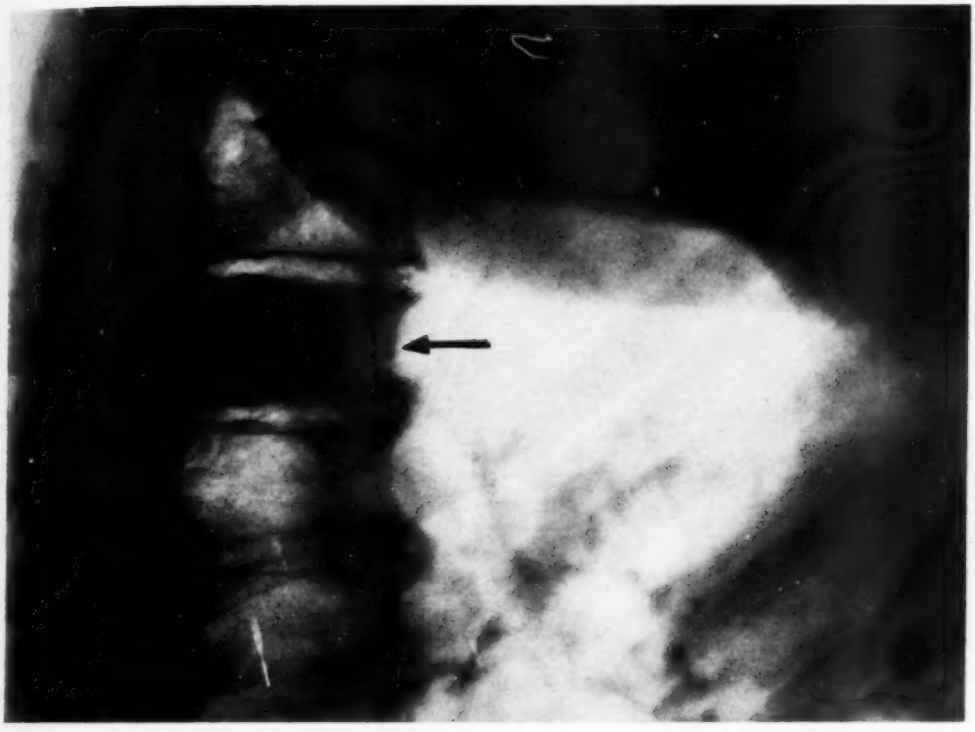

Fig. 3. Vertebral hydatidosis. The vertical dimensions of the vertebral body are preserved; there is no narrowing of the intervertebral space. The invaded vertebra presents a tendency to eburnation rather than to formation of cyst-like spaces.

dary infection, when it responds with the usual characteristics of osteitis (Barcia). There are no changes in the contour of the bone in this stage.

Complications of Radiologic Interest: Infection has already been discussed. It is a late complication. When osteitis occurs, the hyperostotic reaction furnishes radiologic evidence of a process which might otherwise remain unnoticed.

Pathological fractures may occur in the involved bone as a result of the slightest trauma, and may be the first feature to call attention to the underlying lesion, often symptomless theretofore. As stated above, until the invasion of the cortex, the external architecture of the bone remains unaltered. Consolidation of the fracture may occur, but such healed fractures are not always clearly visible on the film and numerous projections may be necessary for their demonstration.

The *ossifluent abscess* produced after penetration of the cortex into the adjacent soft tissues is seen as a rounded shadow on the roentgen film (Fig. 2). While such an abscess may occur in the vicinity of any infested bone, it will be demonstrable roentgenologically only in areas suitable for x-ray visualization, unless a contrast medium is employed. In some cases, calcification of the adventitious membrane simplifies the roentgen demonstration. An ossifluent hydatid abscess complicating hydatidosis of the dorsal spine requires differentiation from pulmonary hydatid cyst. This is not always an easy matter, and it may be necessary to resort to a pneumothorax, according to the technic of Arce, which will settle the question. If the mass is situated within the lung parenchyma, it will collapse along with the lung. Otherwise, it will remain attached to the costal wall.

Radiologic Features of Osteohydatidosis: The spongy tissue of the vertebral bodies is a favorite site of hydatid bone disease. Nearly 50 per cent of all cases of osteohydatidosis involve the spine, with the bony pelvis following in order of frequency (Ivanissevich; Prat and Barcia). Rocher, quoted by Ivanissevich, assgins much significance to the so-called "coffee-bean deformity."

Vertebral hydatidosis shows no tendency to the formation of interosseous cyst-like spaces which weaken the vertebral body. For that reason it is not usual to observe any decrease in the height of the body of the vertebra such as is characteristic of Pott's disease. The intervertebral fibrocartilage is not attacked and the intervertebral space remains free of involvement (Fig. 3). On the contrary, there is often calcification or replacement of the lamina by newly formed bone. Coexistent with the vertebral disease, there is usually involvement of the contiguous rib (Figs. 4 and 5).

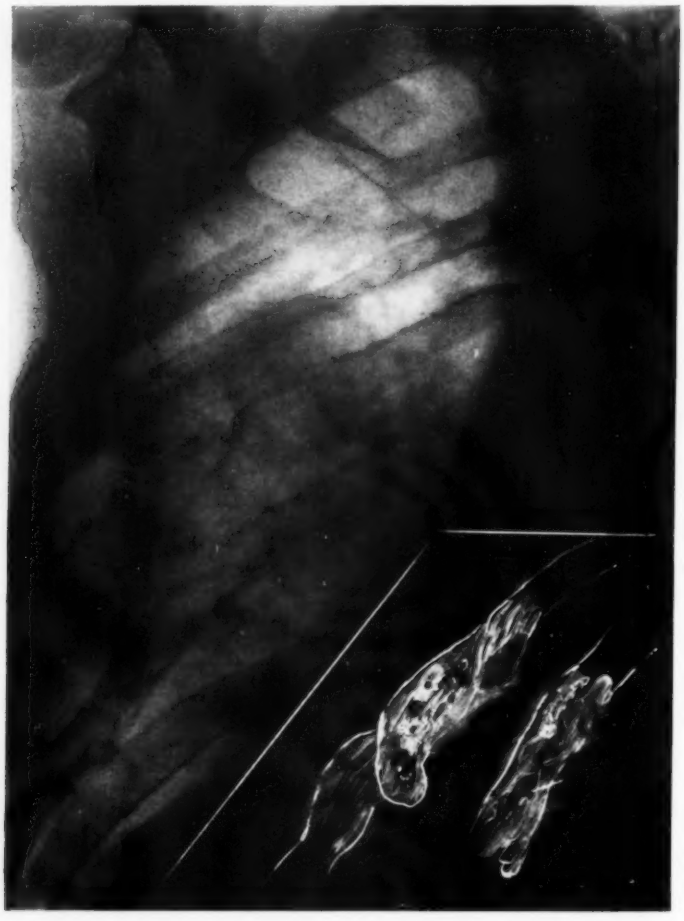

Fig. 4. Hydatidosis of the ribs. There is a change in the architecture and in the shape of the rib with a predominance of cyst-like rarefaction and moderate osteitis.

As pointed out by Garcia Capurro and Ivanissevich, this is a sign peculiar to vertebral hydatidosis and an important differ-

ential feature. The vertebral lamina are often the site of parasitic involvement.

Differential Diagnosis: The first stage of osteohydatidosis may be mistaken for such rarefying bone lesions as osteosarcoma, where an osteolytic process is predominant and the bone shows a characteristic "moth-eaten" appearance. In sarcoma, however, the distinguishing feature is the presence of striations in the periosteal region at right angles to the bone surface—the so-called "sun-ray appearance."

Differentiation from giant-cell tumor may also be difficult, but in the latter there is a sharp boundary between the normal and diseased bone, which is not the case in hydatidosis.

Von Recklinghausen's disease (osteitis fibrosa cystica) may be differentiated on the basis of the multiple involvement in that condition; in doubtful cases a complete examination of the skeleton is indicated. Determinations of the blood and urine calcium lend further confirmation to the diagnosis.

In the solitary bone cyst the bone is "blown up" precociously and there are thinning and expansion of the cortex instead of the infiltration of the spongy tissue characterizing hydatid involvement.

Vertebral angioma may resemble osteohydatidosis radiologically, but the clinical signs are distinctive. Chondromas lack the extensive and diffuse invasive tendency of hydatid disease.

Fig. 5. Coexisting hydatidosis of the ribs and vertebrae. The osteolytic process predominates. Note discrete periosteal reaction of the inferior border of the invaded rib.

Once infection has become established, confusion with the conditions mentioned no longer enters into consideration, since the picture is one of vacuolar spaces separated by bony rings showing all the irregularities characteristic of osteitis. With progressive hyperostosis the bone becomes increasingly opaque, with eventual disappearance of the reticular structure. Mention should be made here of syphilis and tuberculosis, the bony lesions of which are easily confused with osteohydatidosis, especially in the presence of infection.

From the foregoing discussion it is seen that in its earliest stage osteohydatidosis does not permit of an unequivocal radiologic diagnosis. Its occurrence should, however, be suggested by its gradual evolution, its slight effect on the general condition of the patient, and the successive bony changes which are demonstrable on

the roentgen film. In cases of doubt, puncture biopsy may be advisable.

SUMMARY

While osteohydatidosis has no pathognomonic radiological signs, certain more or less characteristic features permit us to make the diagnosis with a fair degree of assurance, namely

(*a*) The osteogenic reaction in the walls of the cyst-like spaces.

(*b*) Lack of a clear demarcation between involved and uninvolved bone.

(*c*) An associated involvement of the adjacent rib in the presence of vertebral involvement.

(*d*) The slow development and absence of any systemic effect even in advanced cases.

Puncture biopsy is recommended in any bone condition where the radiologic and clinical features do not permit of a definite diagnosis. In hydatid disease of the bone such a procedure can be carried out with none of the dangers that would be present in the case of visceral hydatidosis.

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Roentgen Diagnosis of Duodenal Ulcer in the Right Lateral Decubitus Position[1]

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SINCE THE introduction of the roentgen method in the diagnosis of gastroduodenal lesions, various technical procedures have been devised from time to time in order to increase the percentage of accurate diagnoses. The one which has been and is still being extensively used consists of filling the stomach with barium suspension and observing it fluoroscopically, after which one or more roentgenograms are made in the postero-anterior position. In the great majority of cases this technic has been found quite satisfactory for demonstrating the presence of a gastroduodenal lesion. The newer methods include serial films, the compression technic, the spot-film technic, and the use of the filming fluoroscope. There is no doubt that all of these more or less complicated procedures do help in recognizing abnormal changes in the stomach and duodenum, but if the same end can be achieved in a simpler way, as we believe that it can, there is no special advantage in resorting to them.

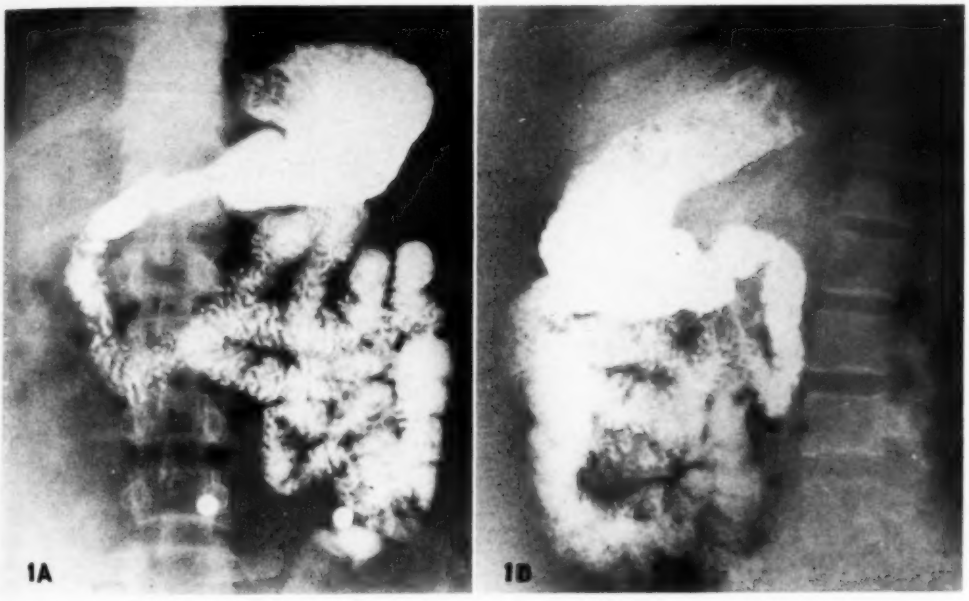

Fig. 1. A. The average type of normal stomach and duodenum, showing the lesser and greater curvatures in the anterior position.
B. Right lateral view of stomach and duodenum, showing the anterior and posterior walls.

The method which has been used in our laboratory for many years with satisfactory results in the case of the stomach and duodenum is based upon one of the most fundamental principles underlying roentgenography, that is, the making of two projections at right angles of any part of the body to be examined. Such a procedure gives one a three-dimensional study of the part under investigation. The value of this technic is fully recognized in general roentgenology; it is equally valuable in

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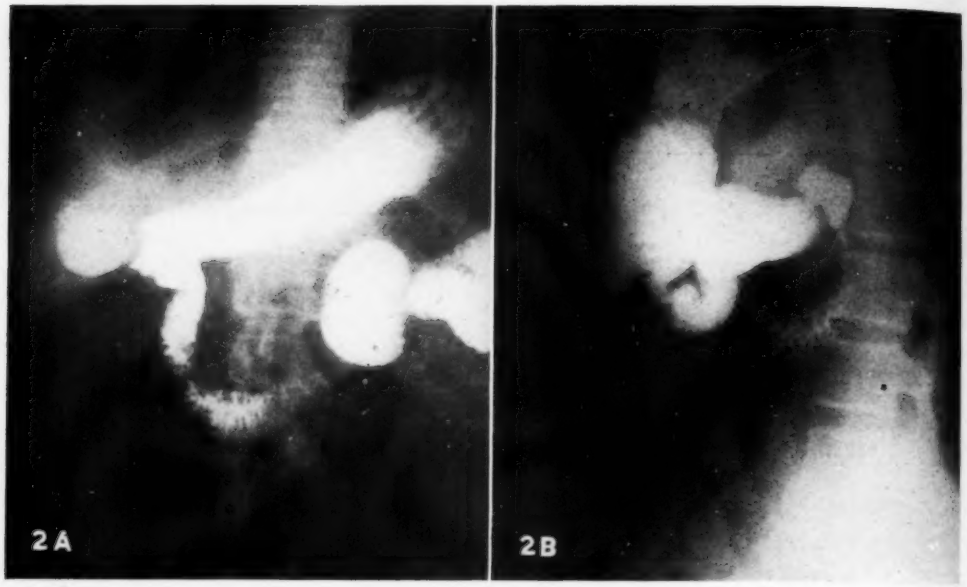

Fig. 2. A. Anterior view of the stomach in a hypersthenic subject. The bulb is completely obscured by the pylorus.
B. Right lateral view of stomach. The duodenum is well outlined in its entire course.

examination of the stomach and duodenum.

The three-dimensional study of the stomach and duodenum is obtained by making two views, postero-anterior and right lateral in the horizontal position. These views are illustrated by Figure 1, A and B, respectively. The anterior view shows the normal outline of the average stomach and duodenum with their lesser and greater curvatures. It fails, however, to show the contour of the anterior and posterior walls, and does not demonstrate the true relationships of the several parts in the abdominal cavity. On the other hand, the right lateral view does these very things. Special attention is called to the anteroposterior direction of the superior segment of the duodenum; this is naturally foreshortened in the ventral position and thus a good deal of the contour, with any possible abnormality, is completely obliterated from sight. Furthermore, in hypersthenic subjects and under certain abnormal conditions, the duodenal bulb is often completely obscured by the overlapping pylorus, as shown by Figure 2, A and B.

The roentgen study of lesions of the duodenum is concerned with three types of bulbs. In the first type the bulb is completely obscured by the pylorus and, in order to visualize it, the right lateral projection is essential. Several representative cases (Figs. 3–6) have been chosen in order to emphasize the value of the lateral projection in this type of duodenum.

In Figure 3, the anterior view (A) shows a steer-horn shaped stomach in which the duodenal bulb is not seen. In the right lateral view (B), the outline of the entire duodenum is clearly shown. The bulb is small, and a penetrating ulcer is noted on its upper surface.

In Figure 4, the anterior view (A) shows the same type of stomach as the previous example, with the bulb completely obscured by the pylorus. In the right lateral view (B) the duodenal bulb is markedly deformed. A large penetrating ulcer is seen arising from its upper surface and a diverticulum from its lower surface.

In Figure 5, the anterior view (A) again shows a steer-horn type of stomach. The pylorus is somewhat dilated and displaced

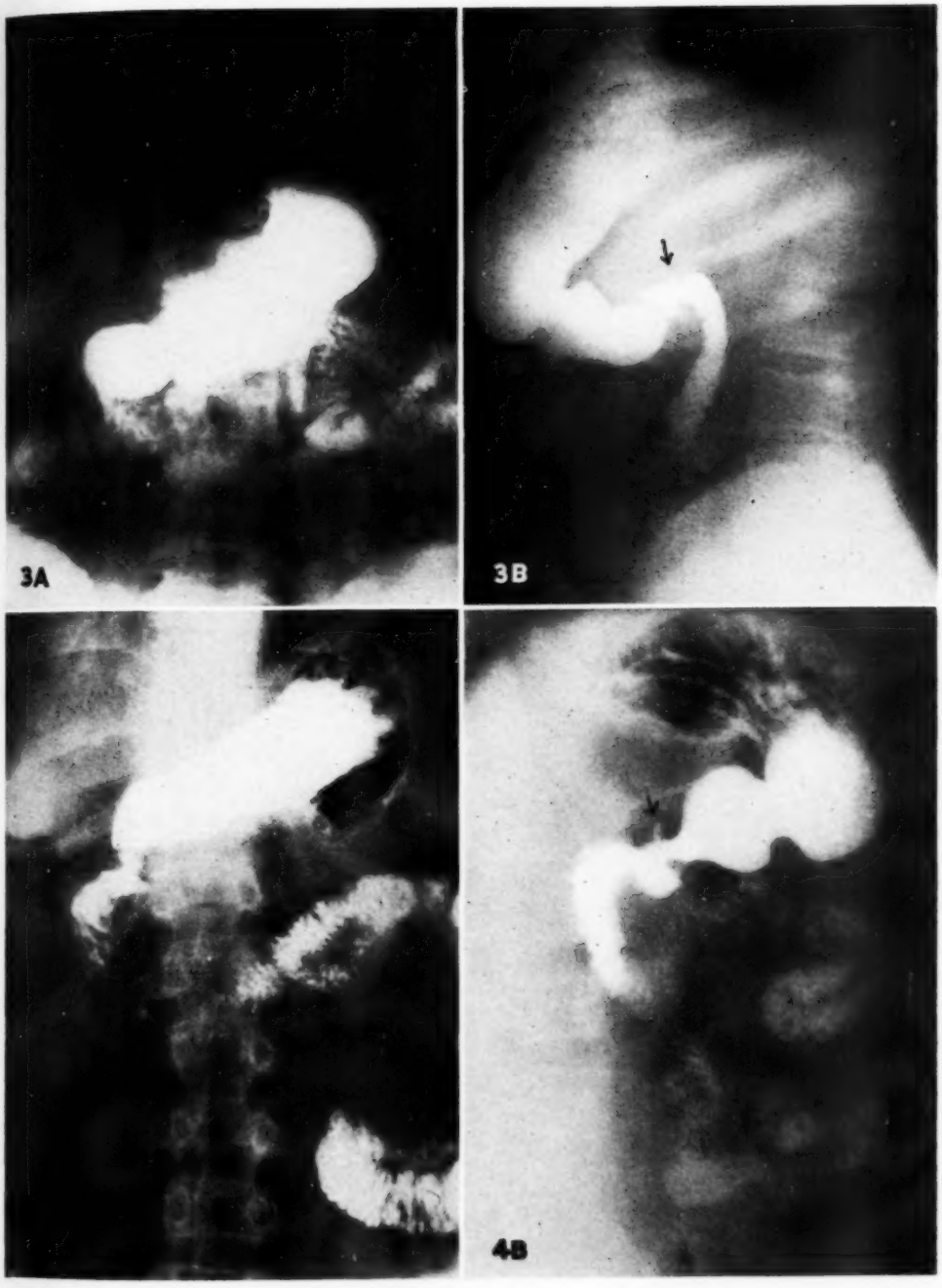

Fig. 3. A. Anterior view of the stomach. The duodenal bulb is completely obscured by the pylorus.
B. Right lateral view. The duodenum is seen in its entirety. The bulb is small, showing an ulcer niche on its upper margin.
Fig. 4. A. Anterior view of the stomach. The duodenal bulb is overlapped by the pylorus.
B. Right lateral view, showing a large ulcer arising from the upper margin of the deformed bulb.

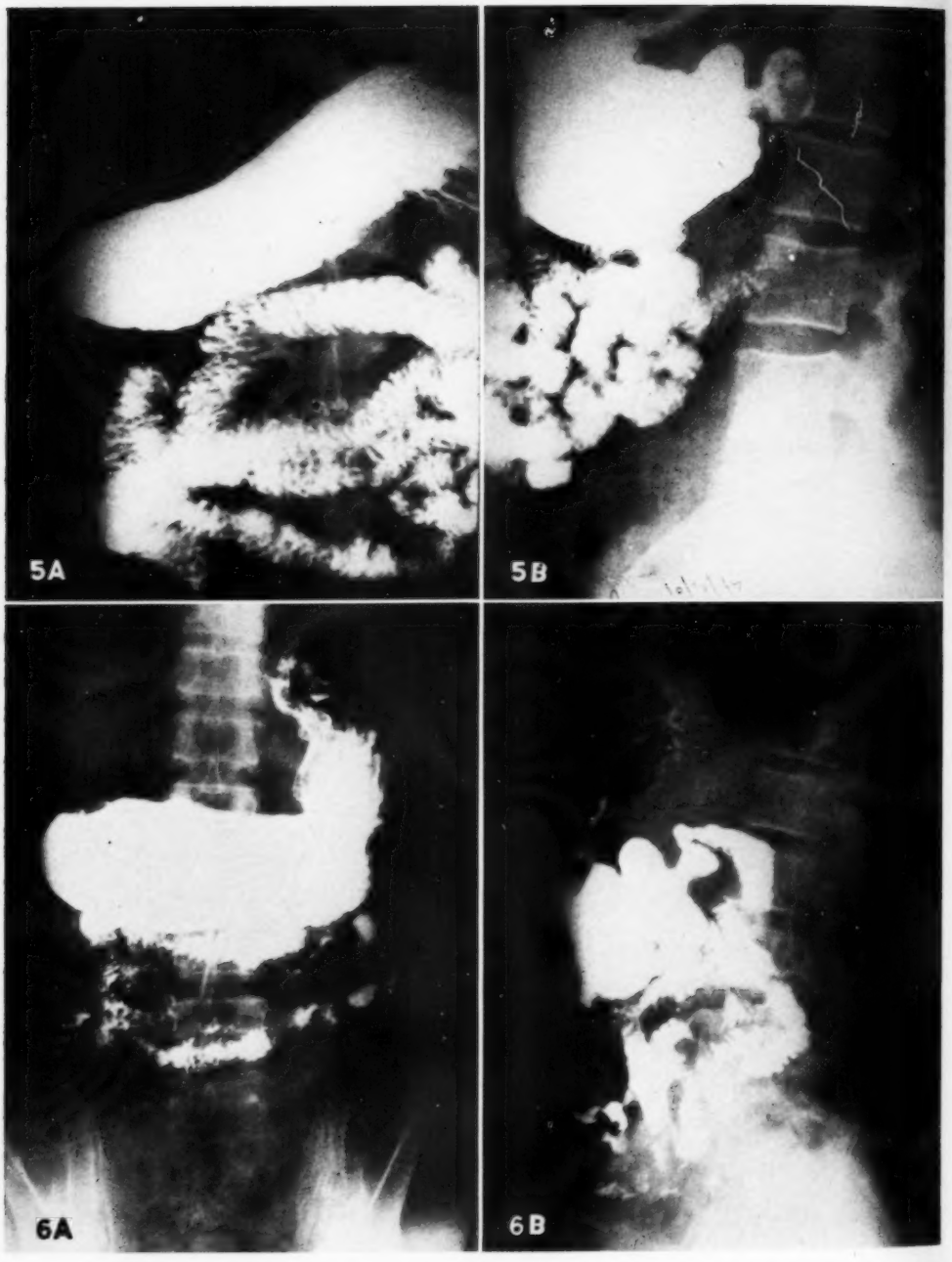

Fig. 5. A. Anterior view of the stomach, which is somewhat displaced to the right, obscuring the duodenal bulb.
B. Right lateral view showing a large ulcer surrounded by a thick ulcer margin.
Fig. 6. A. Anterior view of a dilated pylorus obscuring the duodenal bulb.
B. Right lateral view. The duodenal bulb is narrow and deformed as a result of a chronic ulcer.

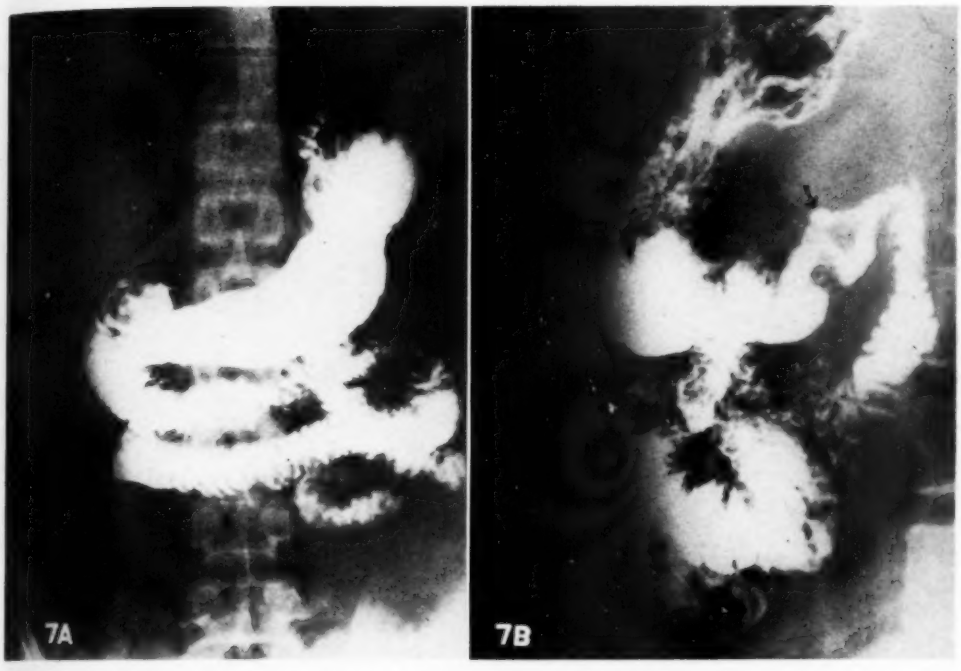

Fig. 7. A. Anterior view of the stomach and duodenum. The bulb is ill defined.
B. Right lateral view, showing an ulcer niche projecting from the upper margin of a deformed bulb.

to the right, obscuring the bulb. In the right lateral view (B), an ulcer crater is seen in the wall of the bulb, surrounded by a halo due to swelling of the ulcer margin.

In Figure 6, the anterior view (A) shows marked dilatation of the entire stomach. The pylorus is displaced to the right, completely overlapping the bulb. In the lateral view (B) the duodenal bulb is shown to be narrow and its contour more or less deformed as a result of a chronic obstructive ulcer.

The second type of duodenal bulb as demonstrated in the frontal projection shows a constant ill-defined contour indicative of a lesion. In the lateral projection, however, the extent of the lesion is often revealed more fully and at times an ulcer crater may be recognized even though not seen in the frontal view. Three cases (Figs. 7–9) have been chosen to represent this type of bulb.

In Figure 7, the anterior view (A) shows an irregular duodenal bulb suggestive of a lesion. In the right lateral view (B) an ulcer niche is readily seen projecting from the upper margin of the bulb.

In Figure 8, the anterior view (A) shows a deformed bulb which is quite narrow. In the right lateral view (B) two ulcer craters are seen arising from the upper margin of the bulb.

In Figure 9, the anterior view (A) shows a deformed bulb which is very small. In the right lateral view (B) a large ulcer crater is seen arising from the lower margin of the constricted bulb.

The third type of bulb is well outlined in the frontal projection and it may easily be passed as normal. When, however, it is observed in the lateral position, the so-called normal bulb may show the presence of a constant deformity indicative of an ulcer. The reason for such a discrepancy is not difficult to explain. As mentioned before, the course of the superior duodenal segment is from before backward, which results in foreshortening of the bulb in the

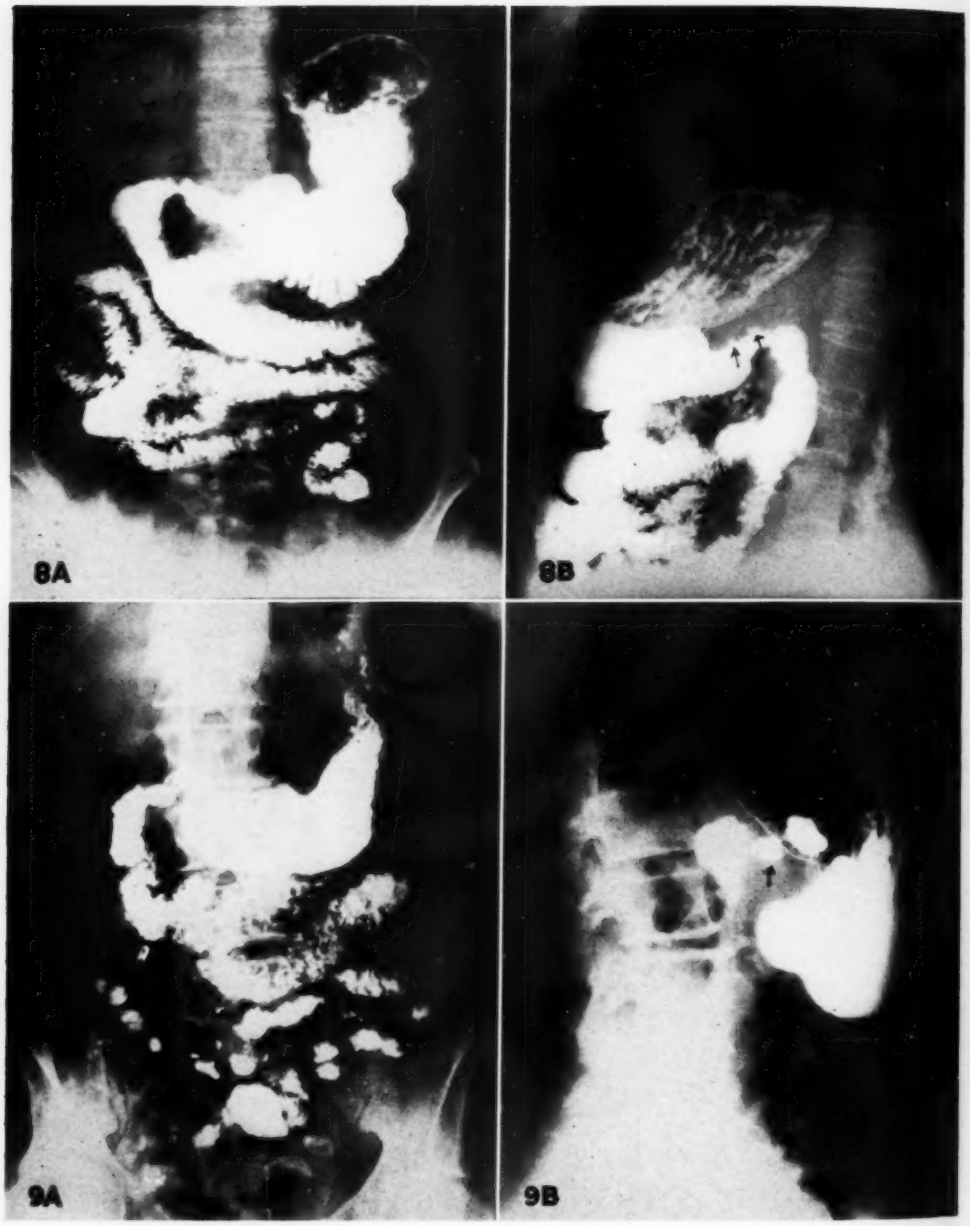

Fig. 8. A. Anterior view of the stomach and duodenum. The bulb is small and deformed.
B. Right lateral view, showing two niches in the upper margin of the deformed bulb.
Fig. 9. A. Anterior view of the stomach. The bulb is deformed.
B. Right lateral view, showing a large ulcer crater with stricture of the deformed bulb.

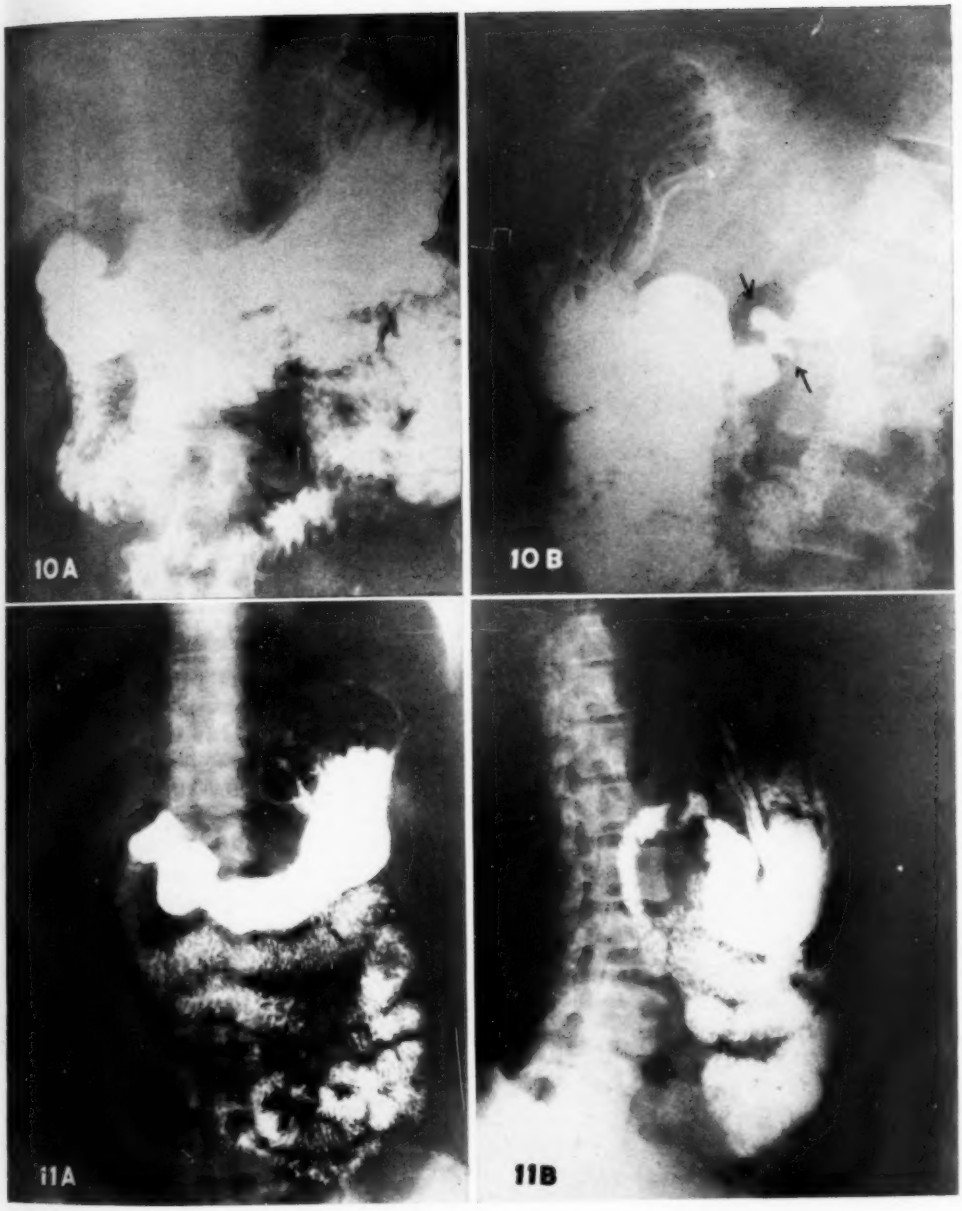

Fig. 10. A. Anterior view of the stomach and duodenum, showing no defects in the contour.
B. Right lateral view, showing a deformed bulb with large ulcer crater.
Fig. 11. A. Anterior view of the stomach and duodenum, showing no defects in the contour.
B. Right lateral view, showing a marked deformity in the contour of the bulb.

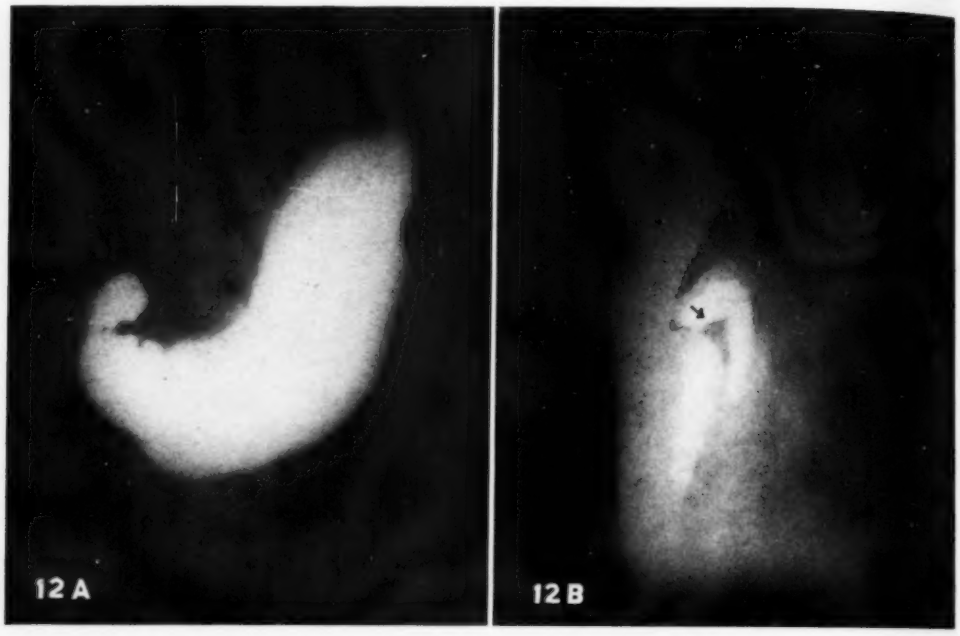

Fig. 12. A. Anterior view of the stomach and duodenum, showing no deformities in the contour.
B. Right lateral view, showing a small niche at the base of the bulb.

frontal projection. For this reason, the lesion is often entirely obscured from sight. Several cases (Figs. 10–12) are presented showing this type of bulb.

In Figure 10, the anterior view (A) shows a bulb which is well outlined, without the slightest evidence of a lesion. In the right lateral view (B), however, the bulb presents a marked deformity in its proximal portion, with a large ulcer crater.

In Figure 11, the anterior view (A) shows a well outlined duodenal bulb. In the right lateral view (B) a marked deformity in the contour of the bulb is demonstrated.

In Figure 12, the anterior view (A) shows a normal stomach and duodenum. In the right lateral view (B) a very small niche is seen arising from the base of the bulb.

CONCLUSION

The fluoroscopic and roentgenographic study of the stomach and duodenum in the right lateral horizontal position has proved to be useful in arriving at a more accurate knowledge of the condition of the duodenum than can be obtained from the frontal projection alone. The fundamental principles underlying this technic are sound and the procedure can be carried out without the complicated devices which have been introduced for the demonstration of gastroduodenal lesions.

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Cancer of the Breast

A Study of Patients Treated Over a Period of Twenty Years in the Radiation Therapy Department of Bellevue Hospital, New York City[1]

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THERE ARE FEW problems of radiation therapy which have given rise to more contention than that of the employment of radiation in the treatment of breast cancer. Is it at all worth while? Is it best administered as an adjunct to surgery, preoperatively or postoperatively, or should it be given solely for palliation in advanced cases? What part does it play in the control of the primary cancer, in prolonging life, in destroying metastatic foci? All these questions have been raised and shuttled to and fro between surgeon and radiation therapist, between general practitioner and specialist. Advocates of one view or the other have offered statistics of all kinds, mostly, however, representing a biased selection.

Bellevue, the largest municipal general hospital in the country, offers an opportunity for intensive investigation and study of all types of cancer in all stages and in sufficient number to permit one becoming conversant with all phases of the disease. Since it offers its services gratis, there can be no issue of cost necessary to the treatment of any specific case. Economic considerations play no controlling interest in the length of time or in the type of procedure employed in the treatment of cases assigned to the various services. Furthermore, because of its association with several large teaching organizations, such a hospital permits of specialization in care and method seldom possible in smaller, less fortunately situated institutions.

Inasmuch as this hospital is available to all citizens, regardless of race, creed, color, economic status, or previous medical care, it receives numerous patients with breast lesions previously seen and often treated elsewhere. Thus, over a period of twenty years, its Radiation Therapy Department has had the unique opportunity of observing not only patients admitted directly without previous medical care, but many who, prior to their admission to Bellevue, have already been treated by surgical, medical, or other special procedures. This has enabled us to note the results of treatment of all kinds administered by others and has permitted a comparison with that which we have been able to initiate. In reviewing the breast cases seen in the Radiation Therapy Department over a period of twenty years we have undertaken to evaluate some of the procedures employed and to give the statistical data upon which we base our findings. Because of the economic instability of most patients seeking charitable medical care, follow-up has not always been possible; nevertheless, in spite of difficulties, we have been able to keep under surveillance a large number of cases for a long period.

Our patients are divided into three large groups; those who come directly to Bellevue Hospital for a primary breast condition; those referred by other hospitals or physicians for irradiation following surgical procedures, or for irradiation for recurrences or metastases; those sent for custodial care.

In 1933 we reported (1) on 230 breast cancers treated in the Radiation Therapy Department of Bellevue Hospital up to

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[1] From the Radiation Therapy Service, Bellevue Hospital, New York, N. Y. Read by title at the Thirty-first Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov. 9–10, 1945.

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1930. This report covers an additional 603 cases bringing the total for a twenty-year period to 833. Only those cases accepted for treatment are reviewed. A large number, too far advanced for any but custodial care, are not included in this study. In our evaluation of treatment as we advocate it, we have based our opinions primarily upon 82 patients seen by us before any form of therapy was instituted, whose treatment we were able to direct throughout their entire illness.

Because New York City has a large Negro population, we would expect to find a large number of Negro patients included in this series. Actually, however, only 10 per cent of those treated, namely 83, were Negroes. There were 674 white patients, 2 were of the yellow race, and in 74 cases the color was not recorded. One hundred and sixty-three of the patients were Jews. While breast cancer is predominantly a disease of the female, our series includes 19 males. Most patients were in the 40 to 60-year age group.

	Cases
20 to 30 years	19
31 to 40 years	153
41 to 50 years	259
51 to 60 years	214
61 to 70 years	152
71 to 80 years	36

The marital status of the patients was as follows:

Females (814)	
Single	122
Married	692
Males (19)	
Single	2
Married	17

Of the married women, 501 had had one or more pregnancies; 2 of the single women had borne children. In most instances only one breast was involved: the right in 416 cases and the left in 372. The disease was bilateral in 45 cases.

As to the effect of lactation on cancer of the breast, we found little difference between women who nursed their children and those who did not. The practice or non-practice of child nursing was recorded in 583 cases. In 440 of these lactation occurred.

Trauma was not frequently reported in our cases, and only 59 patients mentioned it as a possible causative factor. We did not notice that concurrent disease played a very important role; there were recorded only 74 cases with some associated disease process. Diabetes was recorded in only 5 cases, and in these the cancer was of slower growth.

Classification of cases was along clinical lines and depended on conditions present as observed by us. There were 181 cases of Grade I, with involvement limited to the breast and with no axillary or other appreciable metastases; 452 cases were of Grade II, having a breast tumor with appreciable axillary metastases; 203 cases were of Grade III, with axillary and supraclavicular adenopathy; 170 cases were of Grade IV, having involvement of other areas, skeletal or visceral; Grade V included 23 cases with extensive generalized involvement. There were 42 cases of the *en cuirasse* type. Of 151 patients referred from other hospitals, 49 were without appreciable metastases, 95 showed local adenopathy and 2 generalized metastases.

There were 5 cases of breast cancer with associated pregnancy, and in 3 cases the breast lesion developed immediately after pregnancy; 1 patient had recurrence and metastases following pregnancy after treatment of the breast condition had been carried out.

Treatment of all cases was individualized and varied according to the type and extent of the lesion and the condition of the patient. Treatment methods were also dependent upon whether irradiation was preoperative, postoperative, or palliative.

We have advocated preoperative x-ray therapy in all cases but have not always been successful in inducing the surgeon to accept this recommendation. By preoperative x-ray therapy we mean giving an appreciable amount of radiation to the breast and surroundimg areas within three weeks prior to surgical removal of the breast. We do not advocate a longer

waiting period, as this gives the malignant tissues opportunity to recover from the effects of the radiation. It is our opinion that preoperative irradiation, surgery, and postoperative irradiation gave the best results. Of the 82 patients receiving such treatment, 19 are known to be dead; 31 were alive after five to fourteen years. The known survival periods were:

	Cases		Cases
1 year	28	8 years	2
2 years	10	9 years	4
3 years	7	10 years	2
4 years	6	11 years	1
5 years	6	12 years	2
6 years	7	13 years	1
7 years	5	14 years	1

There is no doubt that postoperative irradiation is indicated in all cases and in some it is unquestionably more than a palliative measure. As Gratzek and Stenstrom (2) have also demonstrated in their study of 731 patients seen over a long period of time, immediate irradiation following radical mastectomy gives the best results. With a short interval between operation and irradiation, they believe there is a lessened opportunity for renewed activity of residual carcinoma. They do not accept the statement of others that radiation is responsible for swelling of the arm following radical mastectomy. This, they assert, is due to scarring and secondary infection incident to the operation, and in some instances to metastases. Lung fibrosis can be minimized by employment of a suitable technic. Pettit (3) also advocates x-ray therapy properly administered and in sufficient dosage as a valuable adjunct to operation. He states that most patients with cancer of the breast have axillary metastases even though these are not palpable, and stresses the importance of technic, skill, diligence, and good equipment in radiotherapy as well as in surgery.

Peters (4) regards preoperative irradiation as of distinct value in the treatment of breast cancer, particularly in stage II lesions. Gylstorff-Petersen (5) also considers preoperative x-ray therapy of real worth, regarding it as preferable to postoperative treatment. In his observations at the Radium Center for Jutland he found that irradiation with mastectomy and axillary dissection provided the best results. Nohrman, reporting from Boras, Sweden, is another advocate of the combined treatment, which was more successful than either irradiation or surgery alone, even though palpable lymph nodes were present in the axilla.

The type of operation performed in our series of cases varied considerably depending upon the surgeon and the institution in which the patient had been previously treated. Many types of radical procedure were represented, some extremely extensive and others almost classifiable as simple removal of the breast, superficial muscles, and palpable nodes. In 395 cases the record showed "radical surgical removal." Secondary operations were done in 8 cases.

The pathological report was not always specific, being limited in some cases to the mere designation of carcinoma. Pathological grouping was as follows:

	Cases
Known pathologic type	546
Unknown pathologic type	135
Pathology not recorded	152

Five cases of sarcoma were included, all far advanced when referred for x-ray therapy. Treatment in these cases was palliative and resulted only in amelioration of symptoms and easing of the final agony.

The following pathological types were seen (the designations are those employed by the various pathologists and are not the authors'):

	Cases
Adenocarcinoma	179
Duct-cell carcinoma	286
Scirrhous carcinoma	40
Medullary carcinoma	10
Colloid carcinoma	2
Papillary carcinoma	6
Cystic carcinoma	1
Mucoid carcinoma	1
Plexiform carcinoma	3
Squamous-cell carcinoma	6
Carcinoma simplex	6
Transitional carcinoma	1
Sarcoma	5

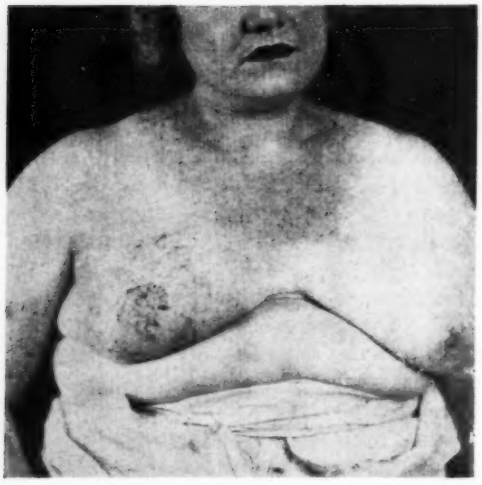

Fig. 1. Cancer of the breast, proved by biopsy, treated solely by radium and x-rays. Patient alive and clinically free from cancer nine years after treatment.

Bone metastases were discernible in 255 cases, the most frequent sites being the spine (49 cases) and the pelvis (48 cases). In many cases there was more or less generalized skeletal involvement. Treatment for bone metastases depended on their extent. For single lesions, treatment was given directly over the affected area; generalized lesions were treated through large portals. The radiation dosage was determined by the purpose of therapy, whether palliative, for relief of pain, or curative. In most instances, even when involvement was extensive, pain was relieved and in many cases healing of the lesion with recalcification was demonstrable on the roentgen film. In cases of bone metastases with pathological fracture, supportive plaster casts were employed and x-ray therapy was administered through these with good results. Healing of fractures following irradiation was often evident roentgenographically.

Lung metastases occurred not too frequently in our series and always marked a poor condition. Irradiation through the lung proved of value for relief of pain, discomfort, and cough but did not control the disease or appreciably prolong life. Pleuritic complications required treatment in the usual manner, including paracentesis for fluid removal when indicated. Liver metastases were always a grave complication and when associated with ascites affected the prognosis unfavorably. Irradiation directly to the liver in some cases ameliorated symptoms, but the ultimate rapid down-grade course was not appreciably arrested. When ascites was present, paracentesis was carried out before irradiation. Cranial metastases occurred in but few instances and irradiation to the skull often alleviated the symptoms from such involvement.

In some cases, because of the patient's unwillingness to permit surgical removal of the breast, or conditions not permitting radical surgery, irradiation alone was employed in the treatment of the breast cancer following biopsy (Fig. 1). There were 165 cases in this group.

TREATMENT

The types of irradiation included x-ray therapy, radium pack therapy, interstitial therapy, and combinations of these modalities. Surgery was employed as a radical measure for removal of the breast, as a palliative procedure for removal of a foul, unhygienic tumor, for secondary dissection of movable axillary or other recurrent masses, and for removal of isolated local metastases. As a rule, for preoperative and postoperative irradiation, high-voltage x-rays—200 kv., with 0.5 mm. Cu, 1.0 mm. Cu, or a Thoraeus filter—were used. The plan of treatment was outlined in accordance with the requirements of the individual case. The dosage depended upon the size of the lesion, age of patient, and presence or absence of metastases. Preoperative therapy was usually administered over ten consecutive days, directed to the breast and anterior chest wall, the axillary and supraclavicular and the post-axillary areas. Postoperative therapy was administered at a slower rate, the amount and direction of treatment being influenced by the condition presented. In some cases of local recurrence and in lesions of the *en cuirasse* type, low-voltage or contact x-ray therapy

was used. Results have not been uniform in such cases. Occasionally local radium has been applied to small recurrences. Contact therapy has given good results, in some instances better than those obtained by other methods.

The effect of irradiation on lymph node metastases has not been satisfactory. Disappearance of already established nodes seldom followed any form of therapy, though occasionally regression of axillary nodes was observed with high-voltage irradiation. Relief of symptoms was often obtained, but supraclavicular lymph node involvement was infrequently affected by the usual form of irradiation. It was in the supraclavicular metastases that we noted the definite value of treatment with the 5-gm. radium pack. Often such metastases completely regressed with this type of radium therapy. Cases with fixed lymph node metastases were considered to offer a poor prognosis.

It has long been known that ovarian sterilization has aided in the control of breast cancer and that orchiectomy has accomplished similar effects in some males with cancer of the prostate. In view of this, an attempt was made by Farrow (7) to secure similar control effects in male and female patients with skeletal metastases from breast cancer, by the administration of estrogenic or androgenic substances. He concludes that it appears that estrogens and androgens have a similar effect on skeletal metastases from mammary cancer. There is evidence that there is some growth inhibition in certain cases following withdrawal of either of these hormones and conversely an excess of either accelerates the rate of malignant growth. Farrow calls attention again to what we have often reiterated: that hormone therapy is to be employed with care in cases of carcinoma. The question of giving estrogens to postmastectomy patients with menopausal disturbances is of importance, for one must recognize "the possibility of activating acquiescent and unrecognized foci of metastatic cancer. In general it would be much safer to forbid pregnancy or the use of estrogens in all cases of mammary cancer for at least five years or preferably longer."

Treves (8) also calls attention to the danger of promiscuous use of estrogens, especially in breast cancer. He condemns their employment to inhibit osseous metastases from mammary cancer as an unwarranted and dangerous procedure, since it stimulates their growth. "The use of androgens to check secondary bone deposits in breast carcinoma in women is an especially bad therapeutic measure." These pronouncements are in accord with the judgment of most informed clinicians who have had the opportunity of observing large groups of breast patients.

Prudente (9), however, states that the prophylactic use of androgens following surgery is of definite value in mammary cancer. He believes that "testosterone propionate exercises a protective or prophylactic action against recurrence of surgically treated mammary cancer." He advocates the use of testosterone even in women past the menopause. Although at first this seems absurd, "one must realize," he says, "that even in elderly women suffering from cystic mastopathia estrogen is found in the breast." In spite of Prudente's favorable reports, the consensus among informed therapists is that androgen therapy in breast cancer is not an effective or proper procedure. In a recent personal communication, however, Adair stated that with the use of massive doses of androgens favorable results are now being noted in some cases. Our results with androgens as yet have not been favorable.

Hochman (10) contends that carcinoma of the male breast is not autonomous and that it cannot be histologically distinguished from the same ailment in the female. "Yet, the etiology of the male breast cancer must clearly be distinct from that of the female breast cancer with regard to all aspects which depend on the function of the mammary gland and perhaps also those which depend on its endocrine regulation." In his series, male breast cancer accounted for 1.65 per cent of the cases. Combined surgery and radi-

ation therapy produced satisfactory results in 9 of the cases treated.

What influence elimination of the gonadotropic hormone has on the growth of breast cancer in the male was investigated by Treves and his associates (11). They studied the effect of orchiectomy on 6 men with cancer of the breast with bone metastases. In the older patients, removal of the testes gave definite relief from pain. In 2 cases, regression of the primary lesion occurred along with restorative effects on skeletal metastases. In the case of a young man no favorable result was achieved, which seems to bear out the general feeling among clinicians that young people suffering from cancer do poorly under any form of therapy.

Regarding the effect of castration upon inherited hormonal influences, Smith (12), studying breast tumors in mice, found it apparent "that there is a relationship between the incidence of breast tumors in mice and the degree of hormonal stimulation. The development of mammary cancer in virgin females of cancerous strains has been demonstrated to be partially dependent upon inherited character. This inherited hormonal influence may also be responsible for the adrenal cortical hyperplasia in castrated mice. The adrenal changes are apparently followed by hormonal stimulation of the uterus resulting in estrus, mammary gland development with precancerous nodules, and eventually the appearance of mammary tumors in those animals with the active milk agent. In the castrated animals without the active milk agent there were adrenal changes but precancerous lesions and mammary tumors have not appeared. Castrated animals having the milk agent but not the inherited hormonal influence may show modified adrenal changes but no other evidence of hormonal stimulation." It will be of interest to discover whether such findings apply to human breast cancer as well.

The question of what to do in breast cancer complicated by existing pregnancy is still a moot one. There were 5 cases in our series. We have felt that in such an event interruption of the pregnancy before the fourth or fifth month is a necessity if the cancer is to be controlled. We doubt whether any measure of treatment after the fifth month will prove effective. These patients are permitted to go to term, while the breast is treated by x-ray and simple mastectomy followed by postoperative x-ray and subsequent radical surgery as the condition may warrant. Castration is then insisted upon to prevent further pregnancies and to reduce, if possible, any potential metastatic development or recurrence.

At present it is an almost universal belief that all patients with breast cancer and bone metastases who have not reached the menopause should have ovarian sterilization whether by surgery, as suggested by Horsley (13), or by irradiation as advocated by radiologists. One cannot be certain, however, that such therapeutic procedure will affect the primary cancer growth or prevent the appearance of metastases, though clinically such effects have been observed in some cases.

Because of the effect of estrogens on cancer, we have advocated sterilization of young women with breast cancer and have carried out this procedure in every case permitting it. Sterilization suppresses the menstrual function and related estrogenic action. Furthermore, pelvic x-ray irradiation, the method used by us, has a favorable general effect on the body and helps to heal and inhibit the formation of skeletal metastases. In substantiation of clinical observations made over a course of years, Adair *et al.* (14) report that in their experience castration materially improves results in cancer of the breast.

Whether radiation sterilization should be limited to younger women with breast cancer is still a disputed question. Pomeroy (15) administers ovarian irradiation irrespective of age. "We have done this," he says, "because we have not known at what age to withhold treatment and because ovarian irradiation adds only a few days to the usual postoperative x-ray

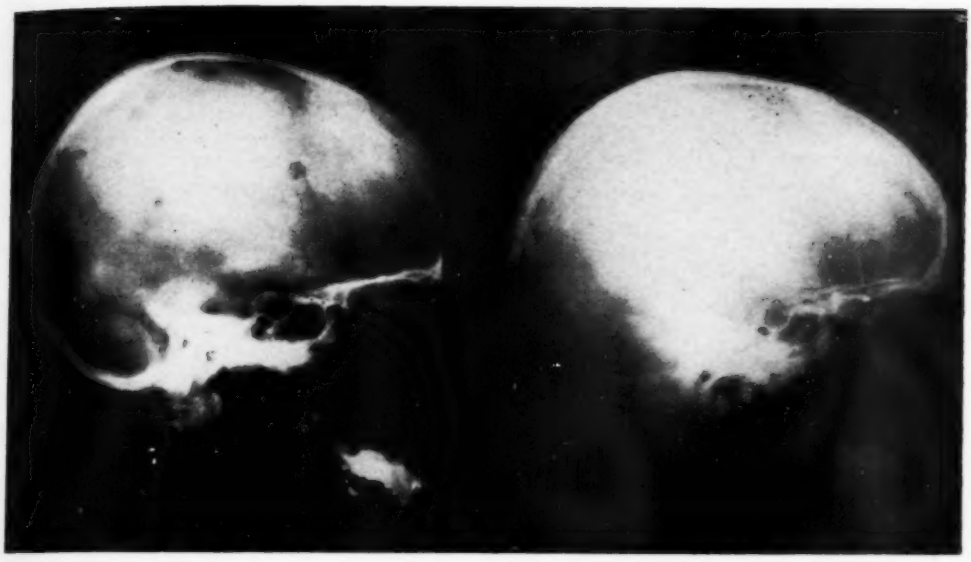

Fig. 2. Skull metastasis from cancer of the breast before and after sterilization by x-rays.

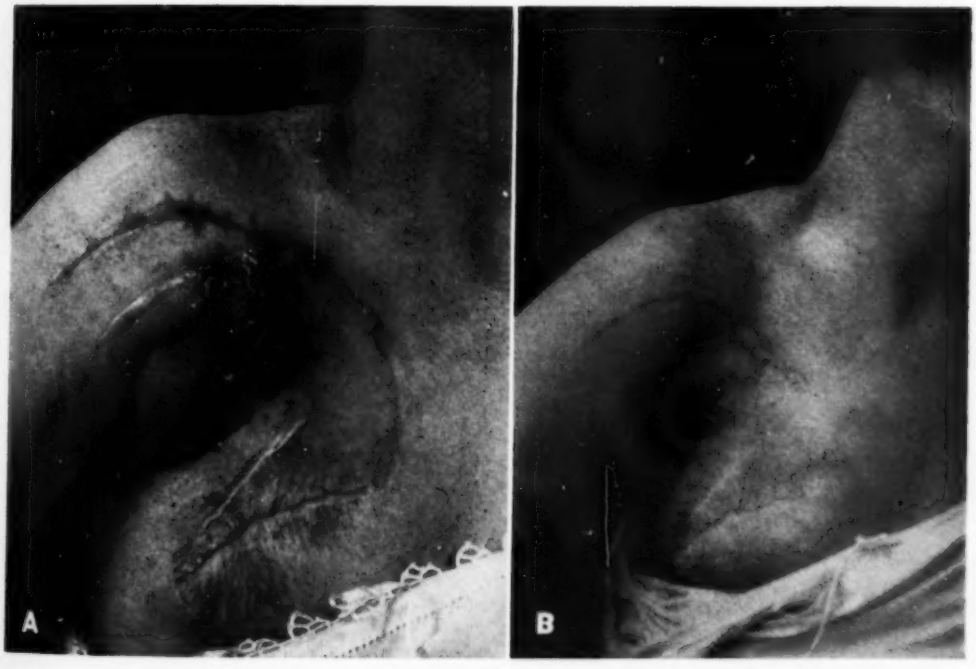

Fig. 3. A. Swelling of the arm and recurrent tumor following operation for cancer of the breast. B. Same patient following x-ray treatment.

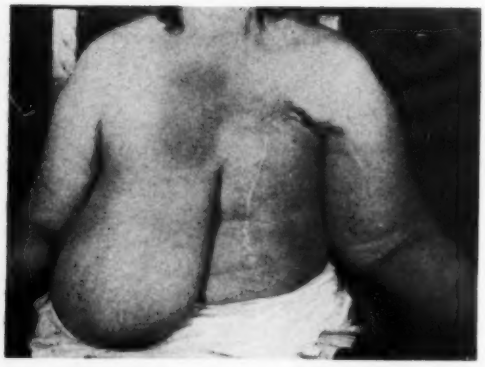

Fig. 4. Swelling of the arm following operation for cancer of the breast.

may be carcinogenic in its effect on the breast and for that reason have advocated sterilization. With cancer already in the ovary, what is the effect on breast cancer? Judging from our cases, this is still a question. Hormone medication had scant effect on the formation of breast cancer as far as we could determine from those cases in which such medication had been employed before the patients were seen by us.

Complications were noted in some instances. Postoperative swelling of the arm was not infrequent, varying from a mild, soft swelling to extensive distortion and fixation of the arm (Fig. 3). We do

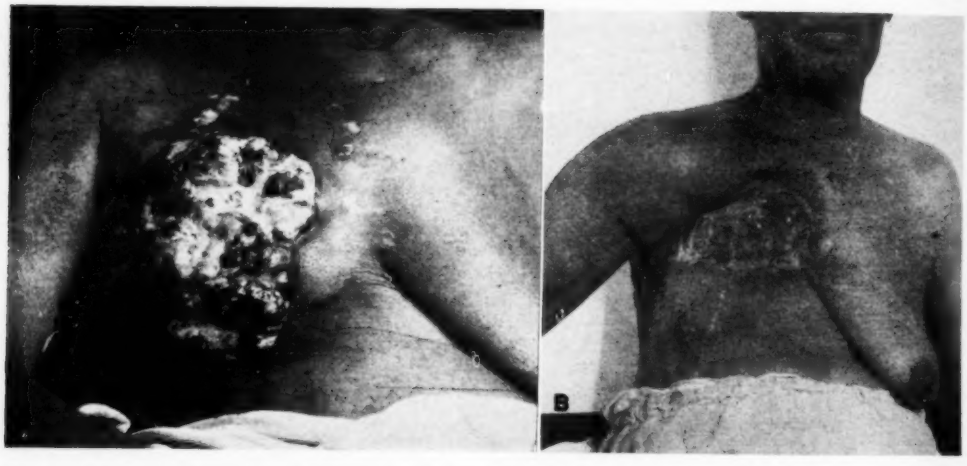

Fig. 5. Advanced cancer of the breast treated by irradiation and surgery. A. Before treatment. B. After preoperative irradiation, surgery, postoperative irradiation, and skin grafting.

series." We also believe that in addition to suppressing menstrual function, and thus reducing the hormone effect on cancer, x-rays produce a general effect on the tissues themselves which tends to control metastatic conditions (Fig. 2).

We have in some cases treated women past the menopause, with the idea that there may be residual estrogenic activity in the ovaries which will be suppressed only by castration.

Carcinoma of the ovary was associated with breast cancer in 8 cases in our series. What significance the ovarian cancer had in the formation of the breast cancer is not clear. We have held that estrogenic action not believe that irradiation was responsible in our cases for this occurrence. In our opinion destruction of the lymph and venous channels was the most logical explanation (Fig. 4). In cases where stripping of the brachial vein was done during the axillary dissection, swelling most frequently followed. X-ray therapy availed little for the relief of this condition, but early postural changes and massage sometimes helped. Recently a surgical lymph drainage procedure carried out by Dr. Samuel Standard of the Third Surgical Service at Bellevue Hospital has given amelioration of this disturbing complication in some cases.

Pneumonitis occurred in only 4 patients irradiated by us. This we attribute to our technic—avoidance of direct therapy through the chest and the persistent use of tangential irradiation. In cases in which treatment had been given elsewhere, additional therapy, even tangentially administered, was apt to increase the possibility of this complication or to accentuate an already present pneumonitis.

In some cases the breast lesion consisted of a bulky, ulcerated mass for which radical surgery was contraindicated. In these cases x-ray therapy sometimes controlled the ulceration, shrank the tumor, and led to local healing. In other cases following irradiation the local condition became operable and subsequent surgery was possible (Fig. 5). In still others, in spite of all treatment, ulceration and necrosis continued, with persistent cachexia and death (Fig. 6).

RESULTS

Of the 82 patients treated by preoperative irradiation, surgery, and postoperative irradiation, followed for a period of five years, 31 are known to be alive and 19 are known to be dead (see page 585). Longevity records for the entire group of 833 cases are appended: 749 cases were followed up to 5 years, 84 patients lived beyond the 5-year period.

Longevity Record

1 year	447
2 years	155
3 years	73
4 years	46
5 years	28
TOTAL (1 to 5 years)	749
6 years	23
7 years	13
8 years	6
9 years	7
10 years	8
11 years	8
12 years	4
13 years	4
14 years	7
16 years	2
17 years	1
21 years	1
TOTAL (6 to 21 years)	84

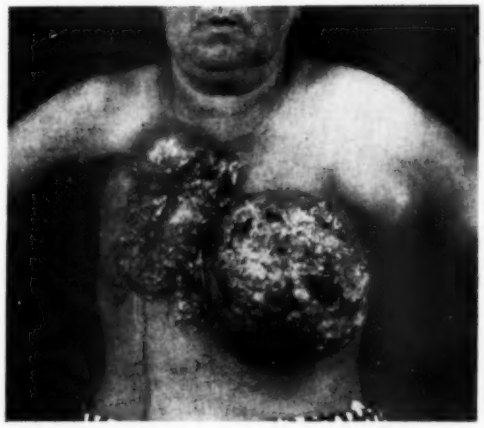

Fig. 6. Advanced cancer of the breast uncontrolled by surgery and irradiation.

CONCLUSIONS

1. Irradiation is a valuable adjunct to surgery in the treatment of breast cancer. The best results are achieved following early diagnosis, with preoperative irradiation, surgery, and postoperative irradiation.

2. For favorable results surgery should follow within three weeks after preoperative irradiation has been administered.

3. X-ray therapy administered at any period after surgery is of definite value in alleviating distress and in prolonging life.

4. Hormone therapy has proved of little value in the control of breast cancer or its metastases.

5. Breast cancer associated with pregnancy offers a poor prognosis.

6. Sterilization in young women with breast cancer is definitely advocated.

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Subacromial Bursitis: Clinical and Roentgen Observations[1]

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IN THE AVERAGE clinic and hospital, painful shoulders constitute an appreciable percentage of ailments treated. In the past five years this percentage has been increasing, and the condition is now encountered almost daily by the general clinician. A source of wonder to the author is the high incidence of cases of long standing, some of which are not only distressing but incapacitating, preventing the patient almost completely from performing his daily work. Whether the patient has failed to visit his doctor in the early days of distress or the physician has failed to take advantage of a complete study need not enter into consideration. The average case is readily recognizable and, with competent procedure, the diagnosis may be made with little or no difficulty. To refrain from a roentgen study of the shoulder joint in this condition is comparable to the omission of a blood sugar test in the care of a diabetic.

Injuries of the shoulder joint are relatively frequent. Our attention is drawn chiefly to fractures and dislocations because of their more common occurrence. Subacromial or subdeltoid bursitis is a traumatic lesion having a lower incidence, but, while its clinical manifestations are at times less dramatic, the condition is crippling and may result in a major disability. The writer has been frequently impressed with these injuries in and about the shoulder joint and has attempted to record the variations in anatomy and surface structures in subacromial bursitis. While such variations occur, certain salient points have been observed in clinical cases which can be considered as an average pattern.

On the roentgenogram are recorded changes in contour of the greater tuberosity of the humerus and variations in outline of the trabeculae. These, with a clinical picture of painful abduction and outward rotation, suggest a lesion of the subacromial bursa. Formerly attention was paid only to the bursa in which calcium deposits were visualized in the soft tissues, either beneath the acromion process or adjacent to the greater tuberosity of the humerus. It is now believed that roughening, excavation, and localized thickening of the periosteum or cortex on the greater tuberosity, indicate, in the greater number of instances, underlying involvement of the subacromial bursal sac (Fig. 3).

That portion of the bursal sac lying between the deep surface of the deltoid muscle and the outer surface of the capsule of the shoulder joint is called the subdeltoid bursa. A delicate membrane may divide this from the subacromial bursa, interposed between the tendon of the supraspinatus, which forms its floor, and the acromion and the deltoid muscle which form its roof. Because of the frequent communication between these bursae, they may be considered as one; together they form a flat, translucent sac, almost invisible when the normal joint is opened, about the size of the palm of the hand (1).

Codman is of the opinion that the subdeltoid, the subacromial, and subcoracoid bursae are one and the same sac, although they may be divided by delicate membranes. For further details as to the structure and location of this and adjoining bursae, the reader is referred to a previous publication (2).

Etiology: Trauma is the underlying cause of subacromial bursitis in the great majority of cases, although the sac is sub-

[1] From Woodlawn Clinic and Hospital, Chicago, Ill. Read by title at the Thirty-first Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov. 9–10, 1945.

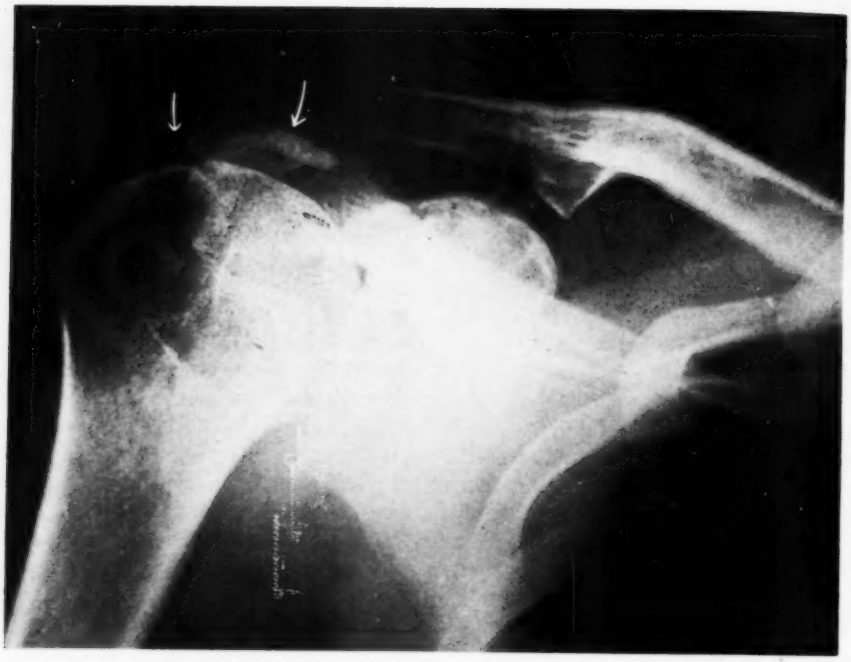

Fig. 1. Calcified subacromial bursitis. Note large calcified placques beneath the acromion process; also the osseous bar or partially calcified coracoclavicular ligament, a bilateral anatomic anomaly. Left shoulder. No pain.

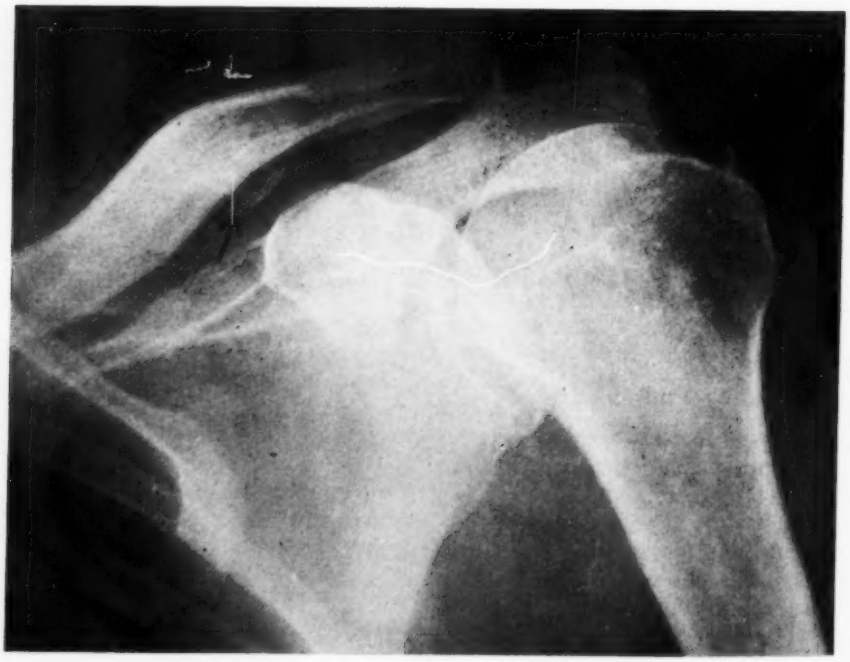

Fig. 2. Right shoulder of patient shown in Fig. 1. Note the small pea-sized calcific deposit in the subacromial bursa; also the anomaly of the coracoclavicular ligament similar to that in the opposite shoulder.

ject, also, to toxic and infectious conditions. To designate the tendinous attachments to the greater tuberosity of the humerus, Codman has used the term "conjoined tendon of the shoulder joint"—the supraspinatus, the infraspinatus, and teres minor. In the erect posture the tendon which initiates abduction—the supraspinatus—functions at such mechanical disadvantage that sudden motions to prevent or guard against blows or falls may result in a partial or complete tear. Other tendinous attachments may be injured or ruptured in fractures of the head of the humerus or the greater tuberosity and adjacent bone, and in dislocations. These tears, whether minute or large, result in laceration of the bursal floor. The sac interposed between the greater tuberosity with its tendinous attachments and the acromion is easily irritated by overuse. These various factors frequently cause the bursa to be crippled by adhesions and result in a state of chronic irritation. In slight injuries to the tendon attachments complete recovery may occur, aided by the education of other muscles to function during the acute stage. With repeated trauma causing more severe injuries, with slight repair, the condition becomes chronic.

Clinical Picture: In most bursal affections, marked tenderness is common and may be localized very early by touch. The movements characteristically attended by pain are abduction and external rotation of the upper arm. The patient usually raises the arm in a hesitant fashion, with many pauses until it is at or near a right angle to the trunk. So much spasm is present in acute injuries that abduction is prevented and, as the condition becomes older, pain is greatly increased when an attempt is made to raise the arm beyond a right angle. Motion is considerably restricted and there is much crippling. Pain may be so intense as to interfere with sleep and require the use of morphia.

Roentgen Findings: In minor injuries the roentgenogram affords little or no information. With fractures of the greater tuberosity, or comminuted fractures of the head of the humerus, one must be prepared if symptoms persist, especially pain on motion, to consider the possibility of subsequent involvement of the bursa. The gap in the contour of the greater tuberosity left by a tear of the supraspinatus tendon invariably involves the bursa, and surgical treatment is usually required. Roughening of the surface and irregularities of the bone texture of the greater tuberosity are common findings on the roentgenogram, changes which may be found only in bone, with no calcium shadows apparent in the soft tissues (Fig. 1). Later, as the condition grows older, calcium deposits occur in the bursal sac, representing nature's attempt to heal the injury or inflammatory process. These calcium deposits vary in size from fine granules of sand to large irregular calcium deposits which may fill the sac beneath the deltoid muscle and even extend to that portion beneath the acromion process. Not infrequently what may appear to be irregular calcium deposits on

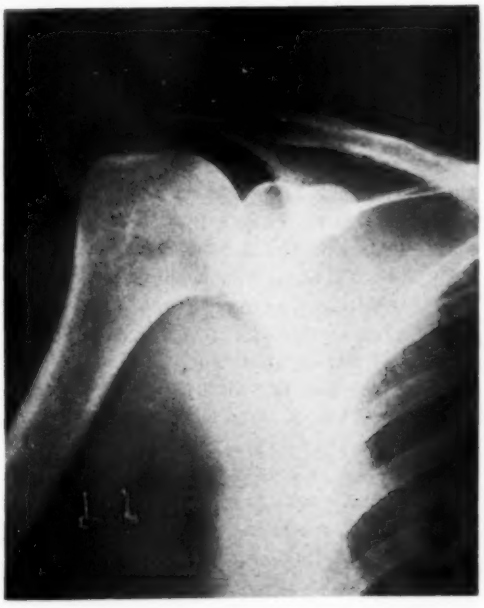

Fig. 3. Subacromial bursitis. Observe the flat, irregular, shallow excavation and straight surface of the greater tuberosity of the humerus. The normal convex surface is absent. The patient experienced acute pain and marked limitation of motion. Roentgen therapy produced dramatic relief. No history of injury. Over two years' duration.

the roentgenogram prove, on aspiration, to consist of fine sand-like particles.

A case is illustrated (Figs. 1 and 2) in which calcium shadows were present in the subacromial bursa of each shoulder. In the left shoulder, beneath the acromion process of the scapula, was a large oval deposit of calcium measuring 3.5 × 1.0 cm., parallel to the lower border of the acromion (Fig. 1). The same patient had an anatomic anomaly of the coracoclavicular ligament. In the outer third of the clavicle, from its lower border, there projected a rectangular shadow of bony density about 1.5 × 1 cm., which appeared to be an exostosis but actually formed a part of the acromioclavicular ligament. This anomaly was present in both shoulders (Figs. 1 and 2).

CONCLUSIONS

Shoulder injuries in which the subacromial bursa is involved are relatively common. The presence of calcareous deposits in the soft tissues, from the acromion process to the greater tuberosity, usually form the main criterion for an x-ray diagnosis. To these may be added changes in the surface of the greater tuberosity of the humerus—excavations, deep or shallow, of varied size, and thickening of the cortex or periosteum. One must keep in mind calcareous shadows lying closely adjacent to bone which partly conceal the deposits. Stereoscopic views and oblique projections may be necessary for their better visualization. Incidentally, in many cases roentgen therapy directed to the bursa will relieve the acute pain in dramatic fashion.

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Significance of Calcification for Roentgen Diagnosis of Aneurysm of the Abdominal Aorta[1]

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OVER 1,000 cases of aneurysm of the abdominal aorta have been recorded in the medical literature but, though roentgen examination is generally recognized as of first importance for the diagnosis (10, 13), comparatively little space has been devoted to that phase of the subject. Actually, the roentgenologist fails to make the diagnosis in 80 per cent of cases despite the presence of adequate evidence on the film (3). Diagnostic criteria which have been mentioned include vertebral erosion (1, 16), presence of a soft-tissue mass (6), organ displacement (5), and calcification (11), with the chief stress on vertebral erosion and practically no consideration of the characteristic calcification. No details were found concerning the differentiation of the calcification of an abdominal aneurysm from that of the common calcified aorta which is the most frequent source of confusion.

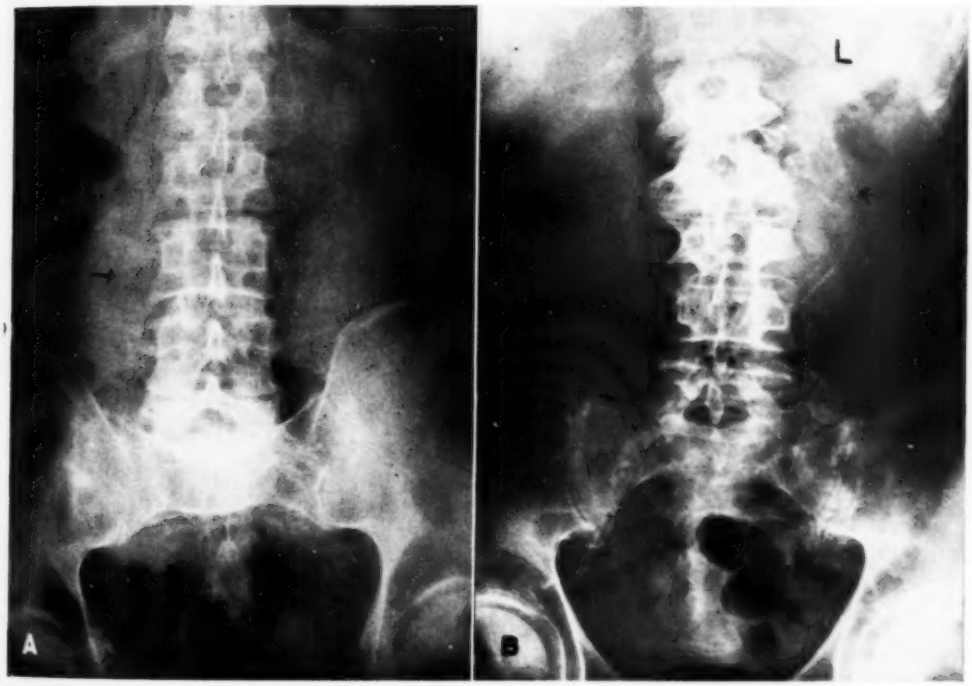

Fig. 1. Roentgen appearance of the characteristic calcification of aneurysm of the abdominal aorta, a single curved line of coarse calcifications in the neighborhood of the vertebral column with its concavity directed toward the column. The greater portion of the aneurysm wall is ill defined because of indistinct calcifications. In contrast to this calcification, that of the common calcified aorta tends to outline the length and width of the structure through the major part of its abdominal course. A. Case I. B. Case II.

Three proved cases of aneurysm of the abdominal aorta recently studied by the writer illustrate the characteristic calcification. One patient had a ruptured aneu-

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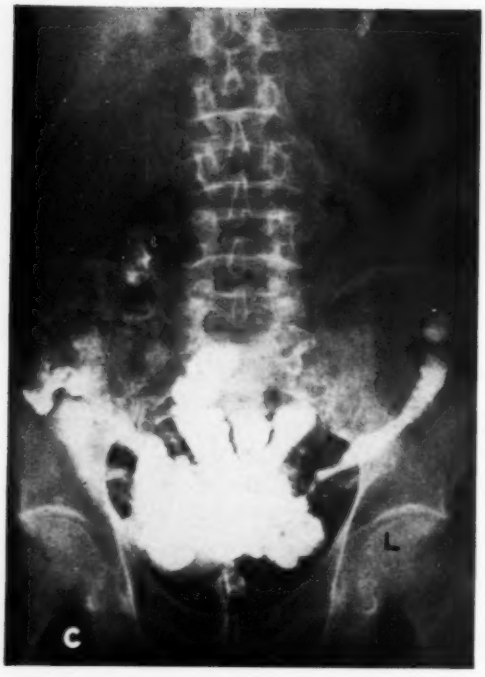

Fig. 1, C. Calcification of aneurysm of abdominal aorta. See also Fig. 1, A. and B.

rysm and showed a rectal filling defect from a blood clot, detectable by barium enema. Attention, therefore, is called to the possibility of the existence of a ruptured aneurysm when the characteristic calcification and a rectal filling defect appear in the same patient.

REPORT OF CASES

CASE I: A. D., an obese 69-year-old white male with hypertension, had been complaining over the past six months of intermittent abdominal pain somewhat more severe in the right lower anterior quadrant. Recently the pain had become worse and the patient was hospitalized with a tentative diagnosis of intestinal obstruction.

A plain film of the abdomen on the day of admission showed a distinct curved line of calcification on the right side of the vertebral column which at first was thought to represent the right border of a calcified aorta (Fig. 1, A). Closer inspection revealed an indistinct interrupted line of calcification opposite the distinct line, completing the outline of a fusiform aneurysm.

A barium enema the same day disclosed at the upper end of the rectal ampulla on the right a sharply demarcated filling defect, 2 cm. in length, with an essentially intact underlying mucous membrane (Fig. 2).

Three days after admission a surgical consultant suspected appendicitis and at laparotomy uncovered a ruptured aneurysm with retroperitoneal hemorrhage and clotted blood producing the rectal filling defect. Section three days later confirmed this observation.

CASE II: J. C., a slender 70-year-old white male with hypertension, suffered for three years prior to death from carcinoma of the prostate, which in the process of growth invaded the bladder and caused obstruction of the ureters. Physical examination one year before death disclosed in the upper abdomen, slightly to the left of the vertebral column, an expansile pulsatile mass the size of a grapefruit. Plain films of the abdomen taken four days before death showed a distinct curved line of calcification to the left of the vertebral column corresponding to the palpable mass (Fig. 1, B). Death was due to uremia. Section showed an unruptured saccular aneurysm corresponding to the physical and roentgen findings.

CASE III: M. L., a slender 76-year-old white male, with hypertension, suffered from angina pectoris for the last six years of his life. Eight months prior to death a coronary occlusion occurred. At this time physical examination disclosed in the mid-abdomen, slightly to the left of the vertebral column, an expansile pulsatile mass the size of an orange. One month prior to death the patient complained of intermittently passing bright red blood by rectum, which was attributed to hemorrhoids found by proctoscopic examination. A barium enema at this time showed a normal colon and a curved line of calcification to the left of the vertebral column corresponding to the palpable mass (Fig 1, C). Death from coronary occlusion followed ten days after the barium enema study. Section showed an unruptured saccular aneurysm corresponding to the physical and roentgen findings.

Epitome of Cases: The three patients were all males over 65 years of age, who for years had performed heavy manual work. All suffered from chronic hypertension and far advanced arteriosclerosis. A definite expansile, pulsatile mass along the course of the aorta was present in two of the cases. The patient in whom rupture occurred was too obese for satisfactory palpation. In this case shock, abdominal rigidity, and signs of internal abdominal hemorrhage were not noted until after operation. It is possible that rupture with repeated small hemorrhages dated from the onset of

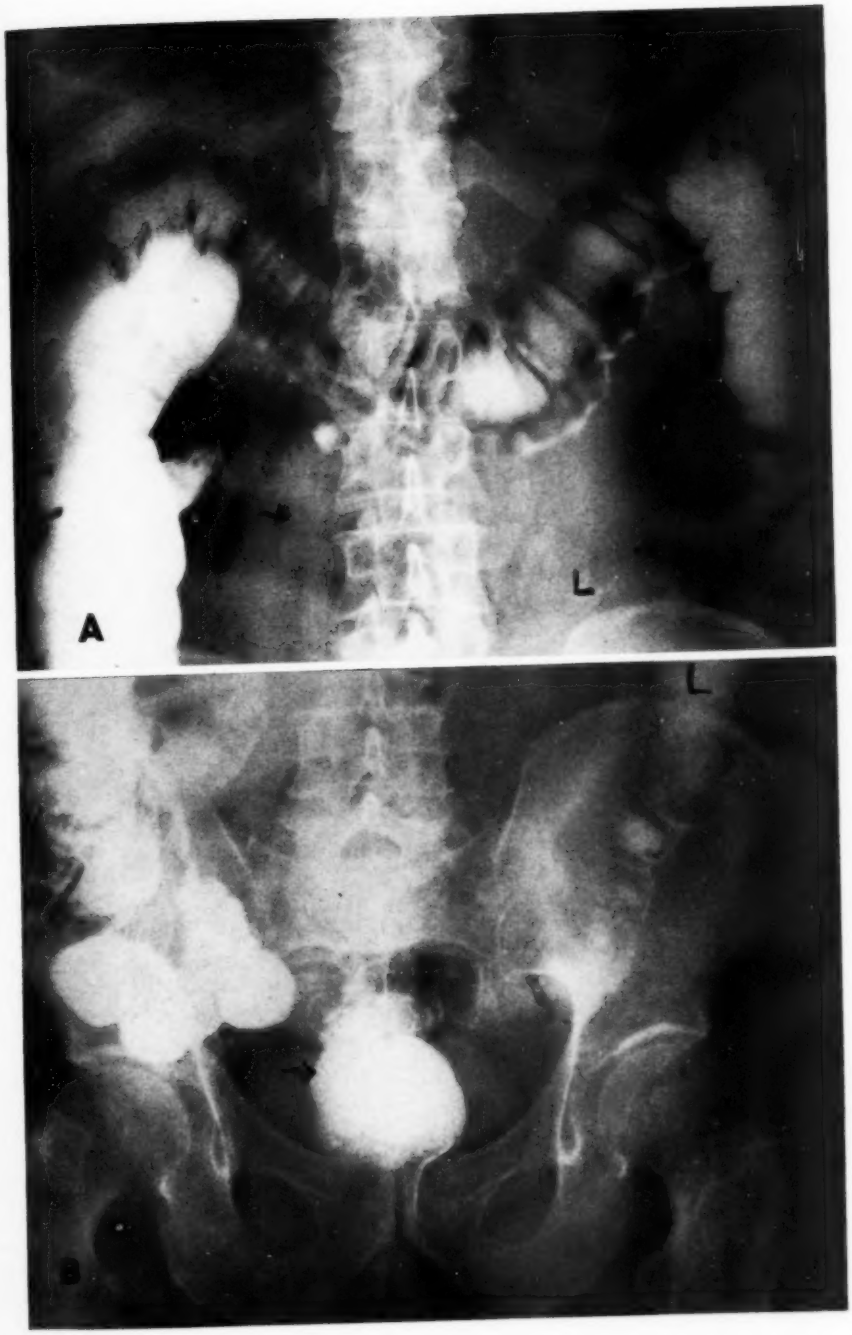

Fig. 2. Case 1. Barium enema study showing filling defect at upper end of rectum due to blood clot from a ruptured aneurysm. This defect resembles closely that from carcinoma but differs from carcinoma by the presence of an underlying intact mucous membrane. The appearance of such a filling defect in a patient with the characteristic calcification of an abdominal aneurysm should suggest the possibility of rupture of the aneurysm.

pain six months prior to death. Nerve root irritation from the hemorrhage probably accounted for the pain, which simulated that of appendicitis. Erosions of the vertebrae were not demonstrated in any of these patients.

COMMENT

Relation of Arteriosclerosis to Abdominal Aortic Aneurysm: Authorities are agreed that the cause of abdominal aneurysm is in most cases arteriosclerosis and not syphilis, which is in contrast to aneurysm of the thoracic aorta (12, 15). Since arteriosclerosis is largely a disease of old age, the possibility of aneurysm must be considered in every elderly patient with sclerotic blood vessels, especially males belonging to the laboring class with a long history of hypertension. A ruptured aneurysm must be considered a possibility when there is associated abdominal pain, especially in the back and left upper and right lower quadrants (7). Because so many people now are living into the years when arteriosclerosis is common, abdominal aneurysms are more frequent and it is correspondingly important that the roentgenologist be able to recognize them (3).

Characteristic Calcification of Abdominal Aortic Aneurysm: In their discussions of abdominal aortic aneurysm Roesler (14) and others (9) state that the plain film almost invariably reveals calcifications, but no details are furnished, and no mention is made of the fact that in most cases the true nature of these calcifications is not recognized. Very rarely calcifications completely outline the aorta and the aneurysm as an opaque mass, rendering the diagnosis easy (4). In the great majority of cases, however, only a portion of the aneurysm wall is outlined on the film by a single curved, continuous or broken, line of calcification; while a considerable portion of the wall is ill-defined because of indistinct calcifications which require for their detection very close inspection, frequently of multiple films taken in various projections (Fig. 1, A, B, and C). Such a unilateral distinct line of calcification, often sharply curved, located either to the right or left side in the neighborhood of the vertebral column, usually with its concavity directed toward the column, is most readily confused with a calcified tortuous aorta (Fig. 3). Consequently it is important that the roentgenologist be familiar with the usual appearances of the calcified aorta.

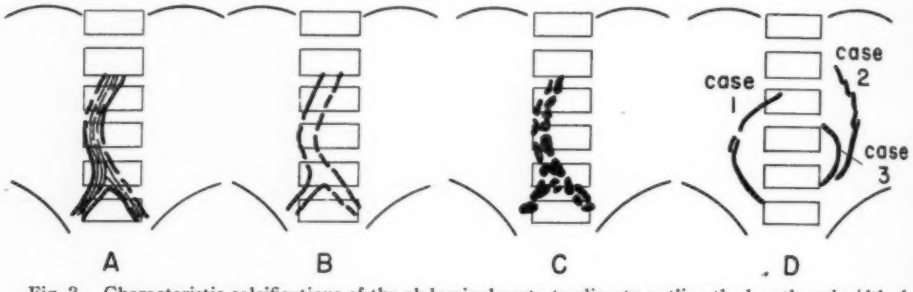

Fig. 3. Characteristic calcifications of the abdominal aorta tending to outline the length and width of this structure through the major part of its abdominal course. A. Type 1, most frequent type, appearing as a band of diffuse calcification with denser lines of calcification marking the width. B. Type 2, appearing as a radiolucent band with dense lines of calcification marking the width. C. Type 3, scattered patches of calcification with no parallel lines marking the width. D. Tracings of the single curved lines of calcification of the 3 aneurysms studied by the writer. Compare this calcification with that of the aorta in tracings A, B, and C.

Characteristic Calcification of the Abdominal Aorta: A search of the literature revealed no adequate details on the roentgen aspects of calcification of the abdominal aorta. In view of this deficiency, films of 50 patients with calcified aortas were studied and in no case was there found a single curved line of calcification such as was ob-

served with aneurysm. In each instance the calcification tended to outline the length and width of the aorta through the major part of its abdominal course. Three types of appearance were noted. Type 1 (25 cases) was a more or less homogeneous band of diffuse calcification with denser coarse lines of calcification marking the width (Fig. 3, A). Type 2 (14 cases) appeared as a more or less radiolucent band with coarse lines of calcification marking the width (Fig. 3, B). Type 3 (11 cases) consisted of scattered irregular patches of calcification with no parallel lines of calcification marking the width (Fig. 3, C).

Other Abdominal Calcifications: Other abdominal calcifications, such as the irregular flocculent or granular calcifications in cysts, cystic teratomas, tumors or tuberculous areas in the kidneys, lymph nodes, hematomas, and perirenal and paravertebral abscesses, are usually sufficiently characteristic to offer little diagnostic difficulty.

Ruptured Abdominal Aortic Aneurysm Indicated by Characteristic Calcification Combined with Rectal Filling Defect: When an aneurysm of the abdominal aorta ruptures, the extravasated blood practically always enters the adjacent retroperitoneal tissue (8). Because of the tamponading effect of this tissue, death may not follow for some time and the retroperitoneal blood, aided by gravity and the anatomical relations of the tissues, tends to flow downward into the lowest readily accessible position in the region of the rectal shelf (2, 3). In this location the blood may clot and produce a filling defect of the rectum detectable by barium enema, as in our Case I (Fig. 2). This defect may closely resemble that due to carcinoma but differs in the presence of an underlying intact mucous membrane. The possible significance of such a defect when associated with the characteristic calcification has been mentioned.

SUMMARY

(1) Abdominal aneurysms are becoming more frequent but are overlooked in 80 per cent of the cases, largely because their calcification is confused with that of the common calcified aorta. In order to avoid this confusion, attention is called to the distinguishing characteristics of the calcifications of the abdominal aorta.

(2) A case of ruptured aneurysm of the abdominal aorta is reported in which the characteristic calcification was associated with a filling defect of the rectum. Attention is called to the possibility of this combination of appearances indicating the presence of a ruptured aneurysm.

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Therapeutic Radiology[1]

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MR. PRESIDENT, ladies and gentlemen: I was not aware until a few minutes ago that my talk this evening was to be the first of a newly instituted series of Annual Lectures. Had I known, I should have prepared a more formal address. As it is, I shall have to speak to you informally from a few prepared notes.

In 1910 I treated my first patient with roentgen rays. In the thirty-five years since then I have used this method of treatment almost daily. Naturally I have accumulated certain notions and ideas about its value as a therapeutic agent and the way it should be used, some of which I shall try to pass on to you. I shall also suggest some of the problems associated with therapeutic roentgenology and the way the American Board of Radiology has tried to meet them.

In the beginning, I should like to emphasize that what I shall say is often not founded on scientific data and may or may not be anything more than one man's opinion, and must be accepted as such.

The American Board of Radiology was organized in 1934. Between then and the present time there has been a considerable change in the status of radiology as a specialty in medicine; some of the change has been due to the work of this Board. One of the first problems with which the Board was confronted was the selection of candidates for examination. Should any physician who used x-ray or radium, either in diagnosis or therapy, be accepted as a candidate for examination? Or should only those physicians who held themselves out to the public as radiologists be accepted? After considerable discussion, it was decided to confine candidacy to the latter group, since the Medical Practice Act in most states does not limit any licensed physician, leaving it to his conscience and the malpractice laws to prevent him from ranging too far afield. It seemed to the members of the Board that it could best serve its purpose by limiting its approval to those men who definitely listed themselves as radiologists and in this way claimed special skill in that particular branch of medicine. Though members of other special groups practise radiology to some extent, as part of their specialty, their own boards, in an attempt to maintain proper standards, have exercised the responsibility of examining them in this field as well as their own field. The American Board of Dermatology is an excellent example.

Another problem which the Board had to meet was the determination of what constitutes a proper knowledge of radiology. Should arbitrary standards be set up which the candidate must meet in order to pass? Or should the Board base its decision on the result of an examination which the average better-trained roentgenologist could pass? After the Board had been in operation for a reasonable length of time, it was fairly easy to establish standards on this latter basis. That they are high as compared with the knowledge of radiologists as a whole is shown by the fact that, of all the candidates who have taken the examinations, one out of three has failed. Until radiological training in this country raises the general knowledge, it does not seem desirable to place the standards of examination above what they are at the present time.

It was early obvious that there was a need for better training in radiology, and the American Board in co-operation with the American Medical Association has helped to establish residencies in teaching hospitals and to see that these residencies

[1] The first annual Holmes Lecture, delivered before the New England Roentgen Ray Society, May 18, 1945.

meet certain standards. At the present time there are slightly over one hundred residencies available. This is not enough, but it does show progress.

There are many problems, however, that still remain to be solved. One of these is what divisions are desirable in the specialty of radiology, and how many types of certificates should be issued? In the beginning, certificates were issued for radiology, roentgenology, diagnostic roentgenography, therapeutic roentgenology, and radium therapy. In my opinion, a man who treats with either x-ray or radium should be familiar with both, and should be competent to use both. About two years ago, the following recommendation to the American Board of Radiology was made by Dr. Douglas Quick, of New York, and myself: that the number of certificates be reduced to three: (1) radiology, which would include the entire subject, (2) therapeutic radiology, which would include treatment both with x-ray and radium, and (3) diagnostic radiology. No action has been taken up to the present, but I still think the recommendation is worth while. That is why I have used for the title of my talk "Therapeutic Radiology."

One might question the advisability of treating therapeutic radiology as a specialty. Would it be better for all candidates to be qualified in both therapeutic and diagnostic radiology? There is considerable difference of opinion on this question. At the University of Upsala in Sweden, under the direction of Professor Gösta Forssell, there is such a division, with a professor at the head of each department. In some universities in this country the development has been along similar lines; in others, a strong effort has been made to keep the department under one head. My own feeling is that if radiology is to be a real specialty of medicine and is to maintain its standards, it should both diagnose and treat. The radiologist who does not treat has not the same standing among the laity as the man who does. Patients get to know the man who treats them and look to him for help and advice. This not only tends to raise his status in the community but also gives him a somewhat different status on the hospital staff.

On the other hand, the man who does therapeutic radiology alone must of necessity see a large number of patients who are in the terminal stages of disease, and work limited to such a type of practice becomes depressing and discouraging. At the present time, the majority of patients treated with x-ray or radium are suffering from some form of malignant tumor. The rapid advances in the treatment of infection with chemotherapy have removed most of these cases from the radiologic clinics. Similar advances may be made in the treatment of neoplastic disease, and it seems to me unwise for a young man, starting in practice, to accept as his only field of endeavor such a narrow, uncertain field as therapeutic radiology.

Let us now consider some of the problems more directly connected with therapeutic radiology. Today the roentgenologist has a considerable field from which to select the kind of radiation to be used in a given case, and he has instruments by which the quantity of the radiation of choice can be accurately controlled. On what then should his choice be based? There is no difference in the biological effects of the various forms of radiation, and there is no magic in million-volt radiation or in radium. Certain fundamentals, however, must be kept in mind. The type of radiation selected in a given case should be that which will be most effective in the area to be treated, without injury to normal tissues above or below it. One should not use heavily filtered high-voltage radiation in treating a superficial lesion, especially if sensitive or vital tissue lies beneath it. In treating nevi which lie over the end of a growing bone, for example, it must be remembered that the amount of radiation necessary to interfere with the growth of the epiphysis is very small. Selection of the kind of radiation thus becomes a matter of considerable importance. This is also true in the treatment of a lesion within a body cavity,

where it is often better to irradiate by the direct application of radium than with x-rays, which must pass through large masses of tissue before reaching the lesion.

The total dosage is another matter of great importance. Probably it is unwise to exceed an erythema dose in treating any non-malignant lesion. Dosage sufficient to cause an erythema will almost invariably result in some skin damage if the patient lives long enough. On the other hand, if the lesion is a malignant one and there is a reasonable chance of cure, one should not hesitate to give a large dose even if permanent damage is likely to result. In cases where cure is attempted, it is well to remember that there are methods of treatment other than irradiation. The radiation therapist should be familiar with these methods and should bear in mind that the mere fact that he can cure the patient by irradiation is not sufficient justification for adopting that method of treatment. Surgical removal, for instance, might offer an equal chance of cure with less risk of permanent damage.

One might ask what is the proper dosage for malignant lesions? A year ago we were shown a group of cases where doses up to 10,000 r had been used, and in some of the group cure of the local disease was obtained. In my opinion, however, a tumor which requires such extreme dosage as this had better be treated by some other means. There seems to be considerable disagreement regarding the minimum dose required to cure a malignant neoplasm. Without doubt there is a wide variation in this dosage. Cures have been reported following doses no larger than 1,000 r, while in other cases failures have occurred with doses as high as 10,000 r. The variation is tremendous not only among different types of tumors but among tumors with the same histologic appearance. In general, it may be stated that up to a certain point increasing radiation produces an increasing lethal effect on malignant cells; beyond that point, additional radiation produces less and less effect. In other words, there are a few cells which are very radioresistant and which persist after the mass of the tumor has disappeared.

It seems to be a generally accepted fact that lymph node metastases from any given tumor are more radioresistant than the tumor itself. If these nodes are deep-seated, there is little likelihood of destroying them with any dose that can be given without irreparable damage to surrounding tissue. Taussig of St. Louis has published a series of cases of carcinoma of the cervix treated by heavy doses of x-ray and radium, in a large number of which subsequent operation disclosed malignant nodes beyond the site of the primary tumor. Meigs of the Massachusetts General Hospital has had a similar experience. Malignant nodes in the pelvis are not destroyed by any radiation that can be safely given.

This statement may not apply to metastases from radiosensitive tumors. That is, if the primary tumor is definitely radiosensitive, it is reasonable to assume that the lymph node metastases are also fairly sensitive, though less so than the original neoplasm. In these cases, therefore, treatment directed toward lymph node metastases is justifiable. Since in many cases the treatment we can offer is palliative only, before deciding on the dosage we must answer the question, whether or not we are justified in subjecting the patient to the discomfort of treatment and the permanent injury resulting from an attempt to cure. Would it not be better in this group to reduce the dose to that which will produce an arrest of growth rather than use one which attempts to eradicate it but is doomed in advance to failure?

We all talk glibly about the "time factor"; but do we know anything about it? The time intervals are often determined by the convenience of the patient and the operator. None of us has tried definitely to find out what would happen if a time period were fixed and strictly adhered to. There is no question regarding the importance of the time factor and its bearing on end-results. Because we should know more about it, a fertile field for investigation lies along these lines.

There are many other questions which are still unanswered. Should treatment be repeated after palliative results have been obtained with the first treatment? Should the first treatment be planned so that more can be given later, or should the maximum dose be given in the first series of treatments in the knowledge that the course cannot be repeated? Up to the present I have taken the latter stand. Perhaps we would help the patient more, provided he were known to be incurable, if we left him in a condition which would allow repetition of the treatment. As treatment progresses, careful observations of the results should be noted and recorded after the manner of medical progress notes. This is often neglected, though obviously important. Some patients require more, some less, treatment than originally planned.

The presence or absence of infection has an important bearing on the amount of radiation which can be given. If an area is heavily irradiated in the presence of infection, serious trouble may result because of the rapid spread of the infection. For example, in treating cancer of the mouth, all sources of infection should be cleared up before treatment is undertaken. This usually means removal of all teeth in the field to be irradiated. In some cases, therefore, it might be wiser to treat the patient surgically and save the teeth.

Combinations of various methods of irradiation, such as radium and x-ray, or of radiation and surgery, have been widely used in the past and still seem to be quite popular in some clinics. Personally, I prefer to do one thing at a time. If x-ray and radium are to be used, it is better as a rule to begin the treatment with x-ray irradiation, following it by radium to destroy any residual tumor, rather than to start with radium and follow it by x-ray. Where combined radiation treatment is given, it should be under the control of the radiation therapist, and it is probably better for him to do both. He should therefore be familiar with the technic required for the application and insertion of radium, and competent to apply it.

When x-ray therapy is combined with surgery, operation usually precedes irradiation. Theoretically, radiation could be used to reduce the size of a large tumor or to sterilize partially a tumor that is likely to become implanted during operation. This sequence, irradiation followed by surgery, would seem to be desirable in selected cases, but it has received little support from the surgeon. He is, on the other hand, generally quite desirous of having postoperative irradiation given. The literature contains numerous reports showing an increase in the number of five-year cures following this combined treatment, but such increases are actually small, and in many instances the data presented are open to other interpretations. If the general principle is accepted that surgery should not be undertaken unless the surgeon feels reasonably certain that he can remove the tumor completely, and that x-ray dosage of less than 3,000 r will not destroy cancer, it would seem wise to restrict surgery to curable cases. In such cases, where the tumor has been completely removed, radiation should be avoided, since it will only cause serious injury to otherwise normal tissue. If, however, after operation the surgeon is convinced that his preoperative diagnosis as to the extent of the disease was incorrect and that he has left active tumor tissue behind, postoperative irradiation is justified. We should, on the other hand, avoid offering encouragement to the surgeon to operate in the inoperable case in the mistaken hope that later we can destroy any residual tumor that he was unable to remove.

If one reviews the progress made in radiation therapy, one is immediately impressed with the advances in physics and in the variety and accuracy of the equipment now available, but one is equally impressed by the lack of a corresponding advance in the clinical management of the patient. The following case history taken from Williams' *Roentgen Rays in Medicine and Surgery*, published in 1901, is an interesting demonstration of this.

"CASE 1: H. N., a young man twenty-five years old, who had been a patient of Dr. H. L. Burrell, and by him was kindly transferred to my service, gave the following history: He had always been well and strong. Three months ago he noticed a small crusted sore on the right side of the lower lip, which he thought was a coldsore. It, however, kept up a constant scabbing, and slowly grew larger. There was no attendant pain, but it had grown 'fairly rapidly' during the past two weeks. The patient came to the hospital for operation.

"A small bit of the growth was removed and submitted to Professor Mallory, assistant pathologist at the Boston City Hospital, for examination. He reported that the growth was an epidermoid cancer. The lesion on the right half of the lower lip was 1.5 centimetres long and about 1 centimetre wide; it was crusted and indurated. A small gland was felt under the inferior maxilla, just to the right of the symphysis. Recently the patient had complained of some pain in the lower lip near and around the lesion.

"The first exposure to the X-rays was of seven minutes' duration, and the patient was placed about 12 centimetres from the target of the tube. The resistance of the tube was equivalent to 1.5 centimetres of air. During the ensuing week daily exposures of five minutes' duration each were made. All the parts except those immediately around the growth were carefully protected by means of a shield made of tinfoil laid over blotting-paper, as described in the treatment of lupus. At the end of this time the crust came off, leaving a clean base, and the induration had apparently diminished. From this time the treatment was about two minutes daily.

"On the eleventh day from the beginning of the treatment the cancer was smaller, the induration was much less, and cicatricial tissue was forming, especially on the right side of the growth. The opening in the protective shield was then found to be much too large, and a shield with a smaller hole was made and substituted for it. On the thirteenth day the induration had disappeared. On the eighteenth day the lip showed marked improvement, though it had not been as rapid during the past few days as during the first week, therefore the length of the exposures was increased during the next ten days to five minutes daily. From that time the healing made such good progress that the time of treatment was reduced to one minute, and the distance of the tube from the patient was increased to about 20 centimetres. The part was kept clean by means of a solution of peroxide of hydrogen, which the patient applied several times a day. The treatment by the X-rays continued in all for about five weeks, and the latter part of the time it was almost nominal. I wished to keep the patient under observation until complete healing had taken place and be ready to resume it should improvement cease.

"Presumably with this patient healing would have taken place more rapidly had the treatment been a little more energetic. Four photographs (see Figs. 223 to 226), two of which show the appearance before the treatment was begun, and two views taken after the healing had occurred, speak for themselves. The enlarged gland could not be felt after treatment."

In what way, if any, did the treatment reported by Dr. Williams in 1901 differ from what we are using in the treatment of superficial lesions today? He emphasized careful daily observations and determined the size of each dose by the reactions which occurred. Perhaps he did this better than we are doing now. He did not treat the patient until the diagnosis was established by biopsy. In my opinion, this is a very important consideration and it is not always being observed today. His daily notes are excellent and he accompanied the case with photographs taken before and after treatment. The only thing he has omitted is a follow-up report. Perhaps the time was too short, but certainly follow-up observations add more to our knowledge than any other single factor.

While it is true that any improvement we have made during the forty-four years since Williams' book was published has been largely due to better equipment, there are certain lesions in the treatment of which experience has suggested some definite ideas. We have increased the duration of life, at least in the patient with Ewing's tumor, by making certain that the entire bone is included in the treatment field rather than confining the area treated to the visible portion of the tumor. By the use of supervoltage irradiation we have been able to give doses up to 3,000 r in such cases without producing permanent skin injury, although in some cases muscle atrophy has resulted. The point that I wish to emphasize particularly is, however, that in the treatment of Ewing's tumor the entire bone should be exposed and the dose should be much larger than that customarily given.

It is well known that tumors of the lymphoma group disappear readily with relatively small radiation doses (600 r ±), but there seems to be some evidence that a dose of this size does not destroy all the cells. While the tumor may disappear

grossly, microscopically, viable cells are still present. With this in mind, I have increased the dose in selected cases, particularly where there was reason to suppose that only one tumor mass existed. In 1940, I treated a patient with such a lymphomatous mass in his abdomen. The abdomen had been explored, and the tumor proved histologically to be a giant follicular lymphoma. It was found to be localized but inoperable. A dose of 1,200 r was given. There has been no further treatment, and at the present time the patient has no complaints and the physical examination is negative. The skin over the area treated is normal. Since this experience, I have used this method in treating similar cases, and I believe the results have been definitely better.

There are certain lesions which it would seem logical to treat with x-ray or radium but in which failure almost invariably results. Among these are carcinoma of the external auditory canal. I have never cured such a case by radiation, and in most of the cases the progress of the disease has been rapid and the result fatal. The only cures on record have been accomplished by radical surgery. I should hesitate to treat such a case with radiation.

Melanotic sarcoma is another disease which does not respond well to irradiation, although there are a number of reports in the literature recommending this form of treatment. In our clinic the surgical results have been most encouraging, and I would not treat such cases with radiation.

Nevi, particularly the so-called birthmark, in small children have been treated with various forms of radiation for many years. They invariably disappear under treatment, but numerous risks are connected with the procedure and moreover, a high percentage of such lesions disappear without any form of treatment. I would warn against exceeding the erythema dose or against treating with any form of radiation when the lesion is situated over the end of a growing bone or about the eye. Some years ago we reviewed all the cases treated at this hospital. A large number of patients returned for observation, none of whom showed any serious injury. The treatment given in this group was a suberythema dose of superficial x-rays, repeated not oftener than every four months. One patient in the group had had two nevi, only one of which was treated, but both had disappeared.

Warts, particularly plantar warts, are easily a source of trouble to the radiologist. The massive doses now generally used in their treatment should, I think, be abandoned. Certainly they should never be repeated over the same area. There seems to be a great difference in the amount of radiation necessary to cause the disappearance of a wart. I have seen warts disappear with a dose of 300 r.

In closing, I should like to leave with you, particularly the younger men, some suggestions regarding the problems which seem to me to need further investigation. The first is the time factor. There is no doubt that this plays a very important part in the end-results of radiation therapy, and yet we know little about it. The problem is a difficult one which will require observations over a long period of time, as well as experimental study. Nevertheless, it should be investigated. The second problem concerns dosage. What dose is necessary to destroy completely radiosensitive tumors such as those in the lymphoma group? Does heavy irradiation promote metastases? Does it produce an immunity to metastases? Some surgeons favor the former theory. The breaking down of a tumor from any cause, particularly if fragments enter the blood stream, might result in metastatic lesions. The majority of radiologists differ from the hypothesis of the surgeons in that they believe that any wandering cells from an irradiated tumor would not have sufficient vitality to produce a new growth. The suggestion has also been brought forward that metastases are actually *less* likely to take place after irradiation. These problems are extremely interesting and should be solved.

Little River Hill
Belfast, Maine

The First Fifty Years of Radiology in America. The Elements Which Have Contributed to Its Growth as a Medical Specialty[1]

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Washington, D. C.

I AM ACUTELY conscious of the honor bestowed upon me by your invitation to deliver the "Holmes Lecture" this year, and I feel no less acutely my own limitations for such an important task. If, however, you would add to my otherwise limited qualifications an appreciation of Dr. Holmes as a broad-minded physician and teacher of medicine, a profound respect for his ability as a radiologist, and an affectionate esteem for George Holmes as a friend, no one could be more highly qualified than I to be the speaker on this occasion.

Doubtless one of the objects in establishing an annual lecture is to do honor to him to whom the lecture is dedicated and to recall those accomplishments and those qualities of mind and heart which we wish to keep alive and active through the years. Indeed, such a project can be permanently successful only if the accomplishments and the qualities which we honor are realities. Otherwise the lectureship has no sound foundation and our attempts to "do honor" are a mere *tour de force* originating in false personal sentiments.

It is therefore appropriate thus early in the series to consider, even though we must do so briefly, the contributions which Dr. Holmes has made to medicine, and the special abilities and characteristics which have made him a great leader and teacher of radiology, a successful organizer and administrator of a constantly expanding radiological department, a colleague and consultant held in high esteem by all members of the staff and one whose influence extends far beyond the bounds of his own department.

Dr. Holmes' radiological career began in the year 1910, when radiology was still in the era of the fickle "gas" tube; when roentgenograms were made on glass plates; when the high-tension transformer and the so-called "interrupterless" machine were just coming into use and most radiologists were still dependent upon the induction coil with its maddening electrolytic or mercury interrupter; when the x-ray "department" was a small room or two next to the furnace and water pipes in the basement, or a closet under a stairway; when the "x-ray man" as he was then called, and as he is still designated by thoughtless or discourteous colleagues, was barely admitted within the bounds of respectable medical circles but was looked upon as a photographer or even as one not far removed from charlatanry; when there was no specialty designated roentgenology or radiology and its entire future was obscure and in doubt. Under such circumstances, with the whole field of medicine open before him, George Holmes had the vision to see tremendous possibilities for the x-ray in medicine and the courage to stake his career on such a faith.

My aim in this address is not to recount the history of the development of radiology in America during its first fifty years. Your own Percy Brown, beloved by radiologists everywhere, Otto Glasser, and many others, have made us familiar with the story of the discovery of the x-ray, the life of its founder, and the contributions of the martyrs who gave their very lives to the development of radiology. It is a drama of work, disappointment, achievement, and tragic personal suffering and early death which now constitutes a magnificent heritage to be claimed by radiologists of the present and future. The full story should be in the intimate posses-

[1] The George W. Holmes Lecture, delivered before the New England Roentgen Ray Society, May 17, 1946.

sion of everyone who follows our specialty today. My purpose is rather to bring to your attention at least some of the qualities and characteristics of Holmes, his predecessors, and contemporaries, which furnished the dynamic for fifty years of continuous progress in radiology, and to try to evaluate some of the events which contributed to that progress.

I was speaking a moment ago of the *vision* which could see future possibilities at a time when there was little in the actual conditions to warrant it. This is a common characteristic which shines out like a beacon in the lives of all of the pioneers in radiology. Indeed, it has been a characteristic of pioneers in every field of human endeavor. It is a spiritual quality which often has little perceptible relation to the so-called "stubborn facts of life." One of your own professors of philosophy here at Harvard has expressed this idea in a famous sonnet entitled "O World."

We may say that George Santayana was a philosopher and could be expected to indulge in poetic flights such as the sonnet to which I have just made reference. But whether you call it "faith," as in his sonnet, which Paul defined as the "substance of things hoped for, the evidence of things not seen," or you prefer to name it scientific prescience based on experience and facts already known, or you think of it simply as the driving power of new ideas, it is nevertheless real and is recognizable as an important characteristic not only of poets and philosophers but of leaders in science as well.

Walter Dodd, who was the founder of the Department of Radiology at the Massachusetts General Hospital and the first teacher of radiology in the Harvard Medical School, and whom George Holmes so worthily followed, had faith in the future of the x-ray in medicine when he was still a pharmacist, a faith that drove him through years of hard work to acquire a medical degree and finally led him to a martyr's death at the age of forty-seven.

Francis Williams, another Boston pioneer in radiology, is an illustration of the truth that the pioneer spirit is a state of mind and has little to do with age. He was forty-three years old when the x-ray was discovered and had already practised medicine for sixteen years; yet he began, within a year after its discovery, to use the x-ray in examinations of the chest. In the years immediately following he practised and preached the value of the x-ray in chest examinations with evangelistic zeal even in the face of doubt and ridicule. In 1901 he published a book of over 650 pages on *The Roentgen Rays in Medicine and Surgery. Five Years of Practical Accomplishment,* which went through three editions. When it is realized that practically all of Williams' work was based upon fluoroscopic observation, the reports of findings and diagnosis in diseases of the chest recorded in his book as judged by our standards of the present day are little less than astounding. It is not generally known that Francis Williams was really the first in the world to examine the human stomach after ingestion of bismuth. This he did on two patients in 1899, using bismuth subnitrate. He was assisted by Walter Cannon, whose classical study of the esophagus had been made in 1898. Williams published a report of his observations in his book in 1901. This, of course, does not detract from the work of Rieder of Munich, who has always been given credit for originating the study of the stomach after ingestion of bismuth, because it was his work which established the examination as a practical method. Rieder's original paper was published in 1904. Bismuth subnitrate was superseded after some years by bismuth subcarbonate, after publication of a paper by Henry Pancoast in 1905, which discussed the poisonous effects of bismuth subnitrate due to formation of nitrates in the gastro-intestinal tract. It was not, according to my memory, until about 1915 that barium sulfate came into general use. The latter had the great advantage of costing about seventeen cents a pound at that time as compared with three dollars and a half for bismuth subcarbonate.

At the same time that Williams was working with the fluoroscope in Boston, Charles Lester Leonard was working in Philadelphia with a small Ruhmkorff induction coil and a Sayen-Queen x-ray tube without protection around it of any kind and was producing roentgenograms of the urinary tract which established the roentgen method for all time in the diagnosis of urinary calculus. Leonard was one of the first of American radiologists to envision the possiblity of radiology as a specialty in medicine. His influence was paramount in the organization of the American Roentgen Ray Society on a sound scientific basis. He succumbed to his x-ray injuries at the age of fifty-one, having worked almost to the last hour of his life in perfecting a report on the status of roentgen examination of the gastro-intestinal tract which was read after his death at the International Congress of Medicine in 1913, in London, by Henry Pancoast, who had succeeded Leonard at the University of Pennsylvania in 1903.

Outstanding among the radiologists of that early pioneer day was Eugene Caldwell, of New York. When the x-ray was discovered, Caldwell was an electrical engineer with no medical training. He was only twenty-five years of age but had already been engaged on important research work on submarine telephony. It was evidence of his genius that at such an early age, with no knowledge of medicine, he became interested in the x-ray very soon after its discovery and as early as 1897 had rented rooms from a surgical instrument manufacturer and had established what was probably the first x-ray office in New York City, making x-ray examinations of patients sent to him by doctors. His struggle to establish himself in the new specialty, to study medicine, and finally to obtain a medical degree in 1905, his various inventions of apparatus, his pioneer work in examination of the nasal accessory sinuses and the kidneys, his work as an organizer of the American Roentgen Ray Society along with Leonard and Hickey, and finally his x-ray injuries, suffering, and death at the age of forty-eight years, all are familiar to those who have listened to or have read the Caldwell Lectures which are delivered annually at the meetings of the American Roentgen Ray Society.

I have sought to find some common characteristics in the early pioneers in radiology, but one is at first impressed more by their differences than by any qualities that they had in common. Consider the four whom I have named. Williams and Leonard were both born in Massachusetts and spent their lives in centers of American culture, one in Boston and the other in Philadelphia. Williams graduated from the Massachusetts Institute of Technology, had his medical degree from Harvard, and spent two years in European universities, after which he practised medicine for over fifty years in Boston. Leonard had his bachelor degrees from the University of Pennsylvania and from Harvard, and his M.D. and later M.A. degree from the University of Pennsylvania. Both Williams and Leonard were well educated and secure in the society of their day. Contrast with them the lives of Dodd and Caldwell. Dodd was born in London and came to Boston as an immigrant at the age of fifteen. He made his living at first as assistant in the chemical laboratory at Harvard and later as assistant apothecary and then apothecary at Massachusetts General Hospital. He had little conventional education. He began his medical course at Harvard in 1900 and finally obtained a medical degree from the University of Vermont in 1908. Caldwell was born in Missouri and grew up in the state of Kansas, where he graduated before he was twenty from the Engineering Department of the University of Kansas. He was an electrical engineer when he established his office to make x-ray examinations for physicians, and it was not until 1905 that he obtained a medical degree from the University and Bellevue Hospital Medical College. It would be a mistake, however, to conclude that because Caldwell's education was irregular and unconventional that

he was poorly educated. On the contrary, he was possessed of a knowledge and culture far beyond most men who boast their college degrees, partly because his innate power of intellect was extraordinary but mostly through sheer hard work and application.

And now I must mention one other pioneer in American radiology without whose contributions to its progress the story would be incomplete. Preston M. Hickey was born in Michigan, when his father was a missionary to the Indians. He had his A.B. degree from the University of Michigan in 1888 and his medical degree from the Medical College of Detroit in 1892. His entire medical career was spent in practice in Detroit and as Professor of Radiology in the University of Michigan at Ann Arbor. When the x-ray was discovered, he was already established in the practice of otolaryngology. So far as I know, he was the only radiologist who was a skilled bronchoscopist. He made his outstanding contributions to American radiology in three fields. Radiological organization was placed on a high plane in the early years of this century by the organization of the American Roentgen Ray Society, and Hickey, Leonard, and Caldwell were the men who established its high medical and ethical standards. The second field to which he gave leadership, beginning with the earliest years, was that of radiological journalism. He personally contributed at least 125 papers to medical literature during his career, but his greatest service in this field was performed in developing a radiological journal. He was the founder and editor of the *American Quarterly of Roentgenology*, which afterwards became the *American Journal of Roentgenology* and finally the *American Journal of Roentgenology and Radium Therapy*. He was editor of the journal until 1916, when James T. Case succeeded him. Perhaps his most important contributions to radiology, however, were made through his work as a teacher at the University of Michigan, from 1922 until his death at the age of sixty-five in 1930.

Here I have named four men who were the fathers of American radiology as we practice it today. Francis Williams has a place somewhat apart. He was essentially a clinician who used the x-ray in his practice. This does not detract from the value of his early and unique contributions to radiological diagnosis, but I am trying to adhere to my subject, which deals with the development of radiology as a specialty. Leonard, who died in 1913, Dodd in 1916, Caldwell in 1917, and Hickey in 1930, were the outstanding leaders of the early days, and it was their individual or combined influence which largely laid the foundations for the present structure. If I were attempting a history of the early days, there are, of course, a large number of important contributors to the progress of radiology who could not be left out. George Pfahler, whose story will some day be told when his work is finished, will have an important place even in the earliest years, especially in the pioneer work in radiation therapy. Frederick Baetjer will be remembered for his early contributions to the radiological diagnosis of diseases of bone; Lewis Gregory Cole will be recognized as the one who placed the x-ray diagnosis of duodenal ulcer on a sound and positive basis; Russell Carman will have a place as an important contributor to radiology of the gastro-intestinal tract, and Henry Pancoast for his work on silicosis. When history is written, many others will doubtless find their proper place in its annals, but I turn again to speak of the four whom I have named—Dodd, Leonard, Caldwell, and Hickey. I have mentioned briefly their differences in origin and training, but let me recall those characteristics which to a greater or lesser degree they held in common. I have already spoken of the extraordinary foresight which gave them the confidence to commit themselves to a career in radiology when to the ordinary doctor, and even to those who were the recognized medical leaders of the day, it held no promise whatever. I speak of this again because, if we are to have continued advance into new fields, there must always

be confidence in the possibility of progress and there must be constant encouragement of that spirit of scientific imagination whenever we recognize it in ourselves or in students or assistants. This very force with which we work every day, the x-ray, should be calling us to take the forward look. Has it not revolutionized our knowledge of the world in which we live? Dr. A. H. Compton, in a recent article, recalls how Professor Michelson, when dedicating the Ryerson Physical Laboratory at the University of Chicago in 1893, had stated that the fundamental principles of physics were then well established and that it remained now only to make more precise measurements of the known physical constants. As Dr. Compton remarks, we were living up to that time in "a determined world, precisely predictable according to laws that were clearly known." It was a world all neatly arranged in known patterns made up of a certain number of elements, each of which in turn was composed of a known number of atoms. Roentgen's discovery fell into that neatly arranged world with an effect upon the physical theories of the day comparable to the effect of the explosion of the atomic bomb upon the social life of our own day. Soon we were living in a world, not of inert elements, but of electrons, protons, and neutrons. The world which had been fixed and determined was a world in flux, seething with constant change in its ultimate structure. Should not we who are working every day with the force which is responsible for our knowledge of the structure of the physical universe in which we live take from these profound changes which it has brought about a lesson in the proper attitude of mind that should be maintained toward the possibility of progress? Should it not be an attitude of eager anticipation; in Wordsworth's fine phrase, of "something evermore about to be?"

From this essential quality of vision, faith in the possibility of progress, or whatever you wish to call it, I turn to another which seems prosaic in contrast but which is necessary to prevent "scientific imagination" from becoming simply "imagination" or visionary wishful thinking. It is a power which all of the pioneers, without exception, possessed, and which Dr. Holmes and every one of his students whom I have had the good fortune to observe have possessed in high degree—the power of accurate observation. It has been a characteristic of all great clinicians and I need not dwell upon its prime importance in the radiologist. We can never be too exacting in training ourselves to observe every detail present upon screen or film. Hickey used to say: "Look at the four corners of the film." Recently I have seen a student who was being quizzed on a film miss the diagnosis because he failed to observe this precaution. The diagnosis was plainly written in white ink on the corner of the film. A good rule to observe when the diagnosis seems quite obvious is to cultivate the habit of re-examining the film for everything else that may be seen which could denote abnormality, and, conversely, when we are priding ourselves upon a diagnosis based upon keen observation and accurate interpretation of obscure deviations from the normal, to look again and again to see if there is not something else glaringly obvious on the film. Of course, if the accurate observer is to secure his best results, he must have films of the best quality. The pioneer workers were all good technicians. To see the really beautiful films made by Leonard or Caldwell with the crude apparatus available to them must often make us ashamed of the relatively poor results that are today turned out in the average roentgen department with the most modern apparatus. The fact that an important diagnosis often depends upon good films must make us exceedingly exacting in our demands for excellent technic at all times.

This is the place to speak of the inventions and improvements in apparatus that have made possible our present marvelous technical results. X-ray tubes were at first small and fragile. The first important advances were made when Campbell-Swinton suggested placing a metal target

within the tube and Herbert Jackson devised a curved cathode to focus the electronic stream on a small area on the target. During the early years of this century there were gradual but important improvements in the construction of tubes; they were made larger and more rugged, and the target was increased in size and thickness and backed by heat-conducting metal and furnished with means of regulating the vacuum. The first great improvement in x-ray apparatus took place in 1908, when Clyde Snook, of Philadelphia, devised the so-called "interrupterless" apparatus. Instead of the induction coil, it used the closed coil transformer and utilized the alternating current by means of a rectifying device of revolving disk or arms. Only those who can remember the annoyances, difficulties, and limitations attendant upon the use of the induction coil with its electrolytic or mercury interrupter can appreciate the revolutionary advance which was made when they were replaced by the high-tension transformer and a device for mechanical rectification of the alternating current. Those of us who lived in communities where only direct current was available were compelled to have our machines equipped with rotary converters, with consequent loss of 50 to 60 per cent in efficiency, but even with this limitation the new machines were a tremendous advance over the coil and interrupter. The new machines were coming into common use in 1910 to 1912 and with their greater output of electrical energy the limitations of the x-ray tubes then available were becoming more and more apparent. Tubes had been improved by the use of tungsten instead of platinum targets, an advance made possible by the work of Wm. D. Coolidge, who had devised a method of rendering tungsten ductile and of compressing it into a solid block, whereas it was before available only in powdered form. This was one of Coolidge's greatest contributions, since it made possible the use of tungsten filaments in electric bulbs and replaced the platinum targets in x-ray tubes with targets of tungsten.

Coolidge's great invention, the Coolidge tube, which made possible the new, modern era of radiology, was brought to practical perfection in 1912. Those whose entire radiological experience is confined to the period since 1912 will never be able fully to appreciate the difficulties of the days of the old "gas" tube. Fickle and undependable as a source of x-rays, it was replaced by an instrument of precision which, with reasonable attention to details, could be depended upon to duplicate results. Coolidge made another important contribution to radiology by development of the first wholly dependable and practical portable apparatus for military use. For this apparatus he invented a new type of tube called the "radiator" tube.

We come down now to the times that most of you can remember. If you were not practising radiology when Hollis Potter devised the Bucky-Potter diaphragm, you undoubtedly know by experience its invaluable place in radiological technic. You have seen the advance made when tomography could be applied simply and easily in every roentgen department, and you have witnessed the perfection of cholecystography and myelography to their present high state of excellence. You do not remember the animated and at times acrimonious arguments that were carried on in our meetings and in our journals concerning the relative value of fluoroscopy and roentgenography in examinations of the gastro-intestinal tract, but you have witnessed the combination of both in the spot-film method of examination. Within very recent years you have seen rotating target tubes come into general use. During the past five years fluorophotographic methods have been perfected to such a degree that they are highly efficient and indeed invaluable for mass survey of the chest. Most recently of all you have witnessed the perfection of a photoelectric timer which operates on fluorophotographic apparatus with uncanny precision.

How far we have traveled in the technical aspects of radiology since those early days of coil, interrupter, and fragile gas tubes! But we are far from satisfied.

Now, at the beginning of the second half century, we are eager to see improvement along many lines. We want further improvement in x-ray tubes so that they will be more durable and dependable; we think the time is ripe for considerable improvement in both x-ray films and intensifying screens; we want manufacturers to devise new darkroom equipment based upon experience gained in industrial plants; we are eager for improvements in fluoroscopic screens and especially for early exploration of the possiblity of electronic amplification of the image. The recent development of cardio-angiography by Robb and others would be greatly facilitated if the fluorophotographic method could be applied to it, and we want to see intensified investigation of the possiblity of utilizing the fluorophotographic method in gastro-intestinal studies and in other parts of the body. While we are looking back at the foundations laid by the pioneers of the last fifty years, let us not forget that among us now must be the pioneers for the advances to be made in the next fifty years.

All of these matters that I have just been discussing are of fundamental importance in the practice of radiology; technological procedures are basic and cannot be neglected. Nevertheless, it was characteristic of the pioneers and of the leaders in each succeeding generation that they did not confine their attention to mechanical and technical details. After all, such details are only means to more important ends. I have already mentioned the attention given by Hickey, Caldwell, and Leonard to organizing the American Roentgen Ray Society, which was the pioneer American radiological society. It has been in continuous existence and active operation since its organization in 1900. One of its greatest services to radiology has been its publication of *The American Journal of Roentgenology and Radium Therapy*. The Society has maintained high standards for membership and its annual meetings and its journal have continuously contributed to the progress of both the science and art of radiology.

The Radiological Society of North America is a different type of association but a necessary and valuable part of radiological organization in America. It originated in the Western Roentgen Society in 1916 and grew out of the necessity for an organization home for the large number of younger radiologists and for many who were doing the limited practice of small communities. After some vicissitudes, it adopted its present name in 1928. The Society has a large membership, including most of those who are members of the American Roentgen Ray Society. Its annual meetings are largely attended and are valuable both from an educational and inspirational standpoint for the great body of American radiologists. The Radiological Society also publishes an excellent journal, RADIOLOGY.

The American College of Radiology was organized in 1923, but it was not until about 1937 that it found a useful place in the total organizational picture of American radiology. It had become apparent before that time that neither the American Roentgen Ray Society nor the Radiological Society of North America could effectively represent the radiologists of America in all of those increasingly important fields which involve public relations, legislation, hospital relations, and education. In that year, 1937, the College secured a full-time executive secretary, established permanent offices in Chicago, and enlarged its membership to include the great majority of American radiologists who hold the diploma of the American Board of Radiology. The College is recognized by both the American Roentgen Ray Society and the Radiological Society of North America, each of which has a member on its Board of Chancellors. It is now recognized generally as truly representative of the radiologists of America and its voice carries the weight of organized radiology when it speaks before the American Medical Association, the American Hospital Association, or any other organization, or to national or local legislative bodies or to the general public through press or radio. The Col-

lege today represents the combined strength of American radiology and deserves the whole-hearted support of every radiologist. It is quite unimportant that the name "College" is not quite appropriate for such an organization. The American Roentgen Ray Society occupies the place which could be appropriately designated "academy" or "college," and the Radiological Society of North America fills the need of an organization home for all radiologists who are interested in improving themselves by contact with their fellows. It seems to me clear that all three organizations are highly desirable and are necessary for the health and continued progress of radiology in America.

The status of radiology was greatly strengthened by the formation of the Section on Radiology of the American Medical Association in 1921. This was the first official recognition of radiology as a separate specialty in medicine. The existence and operation of the section at the annual meetings and publication of its papers in the *Journal of the American Medical Association* serve to strengthen the position of radiology in American medicine and of radiologists in relation to all other practitioners. The section was not established without much work over a period of several years by many radiologists. Its position in the American Medical Association should be jealously guarded and maintained.

To complete the picture of national organization, we must not fail to speak of the organization of the American Board of Radiology in 1934. The Board was sponsored by all of the national radiological societies and each society is continuously represented by three members on the Board. No body is more nearly representative of all American radiologists than is the Board since, in addition to the four organizations I have mentioned, the American Radium Society also is represented. The standing of the Board is now assured, and there is no doubt that its diploma will be of increasing value as time passes.

Radiology in America begins the second half of its first century well organized both for scientific advance and for meeting its socio-economic obligations. There are no important disagreements in its ranks such as were present in earlier years and it finds itself well integrated into general medical organization in the United States.

In all of these activities, from 1911 until his recent retirement, George Holmes had an important part. Typical of his interest and leadership in radiological organization was his part in the formation and operation of the American Board of Radiology. He was a member of the original committee set up by the radiological organizations to make plans and recommendations for establishing a board. He was a member of the Board when it was formed and has remained a member ever since, having served as its president for several years. Among the honors that came to him was the presidency of the American Roentgen Ray Society. All of these offices he has filled with conscientious zeal, but I am sure they always had a secondary place in his mind. His heart and soul were in his professional work. Radiology to him has always been an integral part of medical practice. This has been true of all the great leaders in radiology. They were never content to be less than medical consultants. Hickey and Leonard were clinicians before they became radiologists, and they remained clinicians when they became specialists in radiology. You remember how Dodd and Caldwell never rested until they were qualified to practice medicine. Among all of the leaders since that time no one has more consistently adhered to this method of practice than Holmes. Radiology is essentially a "clinical" and not a "laboratory" specialty. For that reason it is well to speak of the roentgen "department" and not of the roentgen "laboratory." I hold it to be a cardinal requirement that the radiologist shall have personal contact with his patients. It is only so that radiology can be practised on its highest plane. It is my hope that very early in the second fifty years of radiology the practice of relying

upon film reading alone will largely disappear and that everywhere radiologists will follow the best traditions of our specialty which have been established by the leaders during the first fifty years. If they do so, they will find themselves occupying an increasingly important place as honored and valuable medical consultants. That there are any insuperable economic difficulties to the accomplishment of this end, I do not believe. If they do not do so, they can readily be replaced by a combination of the x-ray technician and the specialists in other branches who interpret their own films.

The necessity for closely integrating radiology with clinical medicine is greater now than ever before because of many recent advances in various fields. The advent of chemotherapy and penicillin has brought about important modifications in roentgen criteria which the radiologist can interpret correctly only if he is in touch with the clinical aspects of the case in question. The advances in surgery of the chest are such that it is only by frequent consultation with the chest surgeon and close co-operation with him that the radiologist can render the great service that is expected of him today. The same holds true in the gastro-intestinal tract, the brain, and other fields.

This co-operation that can come about only by frequent consultation between the radiologist and other clinicians is, if possible, more important in the field of therapy than in that of diagnosis. It was in this field that Holmes made one of his outstanding pioneer contributions. The thyroid clinic at the Massachusetts General Hospital, of which he was the main moving spirit, acting as liaison between surgeon and internist, gave the inspiration and example for tumor clinics. It is now recognized that the best method of dealing with the problem of diagnosing and treating cancer is through the well organized tumor clinic, in which the surgeon, the radiologist, the internist, and the clinical pathologist all have equal voice and in which no one of them is dominant. In such clinics the radiologist occupies a strategic position because of the contribution that he must make both to the diagnosis and treatment of cancer.

Even in such a fragmentary account of the place of George Holmes in the development of American radiology as I have been able to give in this address, I cannot omit reference to what has constituted probably the most important aspect of his life's work, the contributions which he has made as a teacher. Among the early pioneers of radiology, Holmes' closest counterpart was Hickey, who was also a great teacher. In personality the two were much alike. I have known them both as quiet, modest, kindly men, who, throughout their lives, took a keen interest in training and developing younger men. Both of them always exhibited a kindly sympathy and understanding in their relations with students and assistants, but both were exacting in their requirements. Their students had to be well founded in pathology, especially in gross pathology, and in their knowledge of internal medicine. Before final conclusions could be drawn in any case, the roentgen findings had to be correlated with the history and clinical aspects of the case. Their students also received thorough training in the technical phases of radiology and were constantly drilled to develop keen powers of observation. The thoroughness and fundamental nature of the training received by the students of both Holmes and Hickey remind one, by contrast, of the sententious reply which Thoreau made to Emerson when the latter said to him that he understood that Harvard was now teaching all branches of knowledge. "Yes," said Thoreau, "all of the branches, but none of the roots." Like all great teachers, Hickey and Holmes inspired their students by their personal example. Both of them occupied places of dignity and influence on their respective faculties and hospital staffs. They demonstrated daily in consultations with individual physicians and in clinical conferences the important place of radiology in the whole medical field.

It is impossible to estimate the beneficial influence of these two teachers upon the development of radiology in the United States through their own personal work and publications and that of their students. Of the two, Holmes' total influence has been the greater because he has trained a much larger number of students than Hickey, who began his real teaching career late in life.

We now enter upon the second fifty years of radiology with a heritage of achievement hardly equalled in any field in any like period of human history. We look back with pride and gratitude to those whose leadership has brought us to this day when radiology is firmly established as a great medical specialty. We look forward confidently but humbly to the future. We feel very keenly the truth of the first aphorism of the founder of medicine: "Life is short, the art is long, the occasion fleeting, experience fallacious, and judgment difficult." We go forward, however, with an optimistic confidence in future progress born of the vision bequeathed to us by the leaders of the first half century of our existence.

In closing, I wish to express to the officers and members of this Society my appreciation for the invitation to deliver this annual address. I am especially gratified that it has been my privilege to give it in the presence of the one in whose honor the lectureship is founded. George Holmes and I are contemporaries in the practice of radiology. At almost the exact time that he chose to enter the field of radiology, I became a radiologist "by order of the Surgeon General of the Army." When I think of the many years of our association, which has become an abiding friendship, I feel like quoting a little verse written by Sir William Watson but quoted by Gilbert Chesterton in reference to his friend Hilaire Belloc:

> "Not without honor my years ran,
> Nor yet without a boast shall end,
> For I was Shakespeare's countryman,
> And were not *you* my friend?"

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EDITORIAL

The George W. Holmes Annual Lecture

On May 16, 1945, Dr. George Winslow Holmes delivered the annual oration of the New England Roentgen Ray Society. Immediately following his lecture, it was proposed, and unanimously approved by the Society, that this lecture be designated the first George W. Holmes Annual Lecture and that each year some outstanding scientist, regardless of specialty, be invited to deliver, at the closing session of the Society, the annual Holmes Lecture.

In creation of this lecture the respect and love of all members of the Society for Dr. Holmes played equal parts. Many members of the group received their training in radiology under his tutelage at the Massachusetts General Hospital, while others have been trained by his intellectual sons and grandsons. Quite apart from this, the respect in which he is held by all members of the Society has increased during the years not only for his ability as a radiologist, but for his zeal and quality in the practice of medicine. He has, furthermore, a quality difficult to describe in words but invariably associated with him: the ability not alone to think clearly but to give expression to his thoughts and ideas with clarity and simplicity for those of us who are less gifted.

Dr. Holmes received his medical degree from Tufts Medical School in 1906, following which he served his internship in the Long Island Hospital and the Boston City Hospital. His first formal touch with radiology came when he was appointed assistant skiagrapher at the Massachusetts General Hospital in December 1910. There he received training under Dr. Walter Dodd. In December 1911 his title was changed to assistant roentgenologist, and in this capacity he continued to be associated with Dr. Dodd until the latter's death in 1917. Dr. Holmes then became roentgenologist at Massachusetts General Hospital, a post which he held until his retirement in 1941. On Sept. 11, 1942, he was recalled to active duty as chief, and served for the duration of the war, until June 1945. The positions held by Dr. Holmes in the Harvard Medical School closely paralleled those at the Hospital. He served as assistant in roentgenology from 1913 to 1917, instructor in roentgenology from 1917 to 1923, assistant professor of roentgenology from 1923 to 1931, and clinical professor of roentgenology from 1931 to 1941. On his retirement from the Hospital in 1941 he was named Professor Emeritus.

There are few of us who have entered the medical field who have not studied Dr. Holmes' textbook, *Roentgen Interpretation*, first published in 1919 and now going into its seventh edition. This book, which has stood the test of time both for students and roentgenologists, is clear, precise, and complete. To realize how well it was originally done, it is necessary only to review the most recent edition and see how many of the original plates and diagnostic methods are unchanged.

As may be judged by reading the annual oration delivered by Dr. Holmes, his interests were divided between diagnosis and therapy. The study of malignant growths and their proper treatment was of paramount interest to him. It was his idea to form the tumor clinic of the Massachusetts General Hospital, which holds high rank today and has been a model for many others throughout the country. The tumor clinic, offering as it does the combined opinions of the pathologist, surgeon,

and roentgenologist, naturally leads to better treatment of the patient and increased knowledge of the disease. The intelligence and the ability to obtain co-operation which enabled Dr. Holmes to establish the first tumor clinic are an unquestionable contribution to the field of cancer research.

Now, after training 45 residents in this specialty and having had 50 graduate assistants under his tutelage for six months or more, Dr. Holmes has returned to Maine, his native state, but he is still interested in our progress. He returned to hear Dr. Arthur C. Christie, an old friend and roentgenologic associate, deliver the second George W. Holmes Annual Lecture on May 17, 1946. The opportunity of reading both lectures, which appear in this issue of RADIOLOGY (pages 602 and 608), will be of inestimable value to both the embryo and the well-developed radiologist. HUGH F. HARE, M.D.

Employment of Persons with Defective Vision as Darkroom Technicians

In September 1944, the Philadelphia Naval Hospital began the use of blinded veterans as x-ray darkroom technicians.[1] This was undertaken both to alleviate the man-power shortage existing at the time and as part of the rehabilitation program for these veterans. The initial test met with such success that the practice has not only been continued in the Philadelphia Hospital but has been incorporated as part of the rehabilitation program for the blind at Army Hospitals at Avon, Conn., and Valley Forge, Penna.

The selection of personnel for this task must be carefully undertaken, as the blind are subject to all the faults of the sighted, with the additional handicap of diminished vision. The work requires intelligence and a sense of responsibility along with meticulous attention to details in order to minimize mistakes. There is no doubt that personnel with light perception learn faster and make fewer initial errors than the totally blind. Once the routine is memorized, however, work progresses smoothly. As is well known, the average technician usually shuns this type of work simply because it is confining and must be done in partial darkness. The man or woman with diminished sight does not mind this restriction and is stimulated by the responsibility placed upon him.

Few modifications in equipment are necessary. After the temperature of the inflowing water has been controlled, a strict time schedule in developing and fixing is followed. Braille aneroid type thermometers are manufactured by the Perkins Institute for the Blind, of Watertown, Mass. These may be partially enclosed, for protection, in a copper case and submerged in the developing solution. A source of error of one to two degrees between the air and water temperature exists, but this variation may be recognized and adjusted with experience. With accurate thermostatic control this error is minimized. The usual interval timer is adapted by fixing lead shot to the face with adhesive. A metal pointer may be fastened to the setscrew if the face is covered by glass.

In addition to the World War II veterans with diminished vision, there are in many communities others similarly handicapped, who are deserving of the opportunity of gainful employment. These people as a group want no favors, but are extremely grateful for the opportunity to prove their ability at certain tasks. Darkroom work fits in this category. This job can be ably handled by the blinded, particularly in hospitals or offices with sufficient work-load to utilize full-time darkroom help, while other employees assume the more demanding technical duties elsewhere. ELLWOOD W. GODFREY, M.D.

[1] GERRY, ROGER A., AND KOCH, FAITH C.: X-ray Darkroom Training as an Adjunct to the Rehabilitation of the Blind. U. S. Nav. M. Bull. 46: 1382–1387, September 1946.

MINNESOTA RADIOLOGICAL SOCIETY

At the meeting of the Minnesota Radiological Society in Rochester, on Oct. 26, the following program was presented.

Radioactive Iodine in the Treatment of Exophthalmic Goitre.....*S. F. Haines*
Unusual Case of Giant Cell Tumor of Bone Treated with X-Ray.....*J. J. Wells*
X-Ray Treatment of Malignancy of the Testis.....*E. T. Leddy*
Review of Different Methods of Radium Therapy for Carcinoma of the Cervix.....*L. M. Vaughan*
Essential Principles of Radium Therapy for Carcinoma of the Cervix.....*H. H. Bowing*
Role of Alpha and Beta Particles in Radium Therapy.....*R. E. Fricke*
Loss of Radon from Radon Ointment.
M. M. D. Williams
Amebiasis in Naval Personnel.....*John D. Camp*
A Case of Diffuse Lymphomatous Involvement of the Colon.....*Harry M. Weber*
The Clinical Syndrome Associated with Pulmonary Arteriovenous Fistula: Report of a Case.
H. B. Burchell
Motion Picture: A Case of Pulmonary Arteriovenous Fistula...*H. B. Burchell and O. T. Clagett*
The Diagnosis of Carcinoma of the Stomach by Chest Radiography.....*B. R. Kirklin*
Thymic Tumor Associated with Myasthenia Gravis.
C. Allen Good
Scleroderma of the Viscera.....*David G. Pugh*
Lesions of the Small Bones of the Feet: Neurotrophic or Infectious?.....*John R. Hodgson*

The dinner speaker, introduced by Dr. Charles Sutherland, was E. J. Baldes, who took as his subject "Europe Today."

TEXAS RADIOLOGICAL SOCIETY

The next meeting of the Texas Radiological Society will be held at the Rice Hotel, Houston, Jan. 25, 1947.

INDIAN JOURNAL OF RADIOLOGY

At the First Indian Congress of Radiology, held in Madras in February of this year, it was decided to undertake the publication of an *Indian Journal of Radiology*. The new journal is to appear quarterly under the auspices of the Indian Radiological Association (155–157 Poonamallee High Road, Kilpauk, Madras). The editors are Dr. P. Rama Rau and Dr. K. M. Rai, both of Madras.

PROFESSOR H. HOLTHUSEN

The following excerpts are from a letter received from Professor Holthusen of Hamburg, Germany, by Dr. E. R. Bowie of New Orleans. We are indebted to Dr. Bowie for permission to reproduce them here.

"Taking into account the extraordinary circumstances of the time being, my family and myself are well off. Certainly we can never forget that our eldest son did not return from service but fell towards the end of the war near the German frontier in Luxembourg. My two younger sons, who also served in the army, returned safely without being seriously injured. They are now students at the University of Hamburg. We had the unlikely chance to save our home during the whole time of air-raids and still to live in it, although of course we have given away part of it to fugitives and out-bombed persons, so that we ourselves are now restricted to the upper floor. I lost my private Roentgen Laboratory July 1943 by fire but had the chance to save my "Strahleninstitut" at St. Georges Hospital. So I am able to continue my work as the Radiologist of that hospital. Under present conditions it would have been impossible to rebuild the plant if it had been destroyed.

"Certainly we have to face many difficulties arising from the very severe housing question and concerning the feeding question, a problem especially complicated in the big towns. . . . Nevertheless, we are looking forward with good hope and we were widely encouraged by the speech delivered by your Prime-Minister Byrnes at Stuttgart last week. [Dr. Holthusen's letter is dated Sept. 9, 1946.] The amount of material and spiritual destruction in our country is enormous. The cutting off of all communications with our friends abroad in consequence of the isolation provoked by the narrow-minded and criminal policy of the Nazis belongs to it. Only very gradually we shall be able to repair these damages. While I hope that in times to come the relations with our colleagues abroad and the co-operation with them will be restored, I feel that it is still much too early to show any activity from our side. I consider it a great privilege for me that you have again extended your hand towards me. Your letter has indeed produced in my heart very warm feelings of thankfulness and the memory of so many lucky hours spent in your country, especially during my first journey to the United States in 1929."

In Memoriam

CARL F. DICK, M.D.

Dr. Carl F. Dick, a pioneer in the field of x-ray equipment and founder of the Dick X-Ray Company, died on Oct. 20. Dr. Dick was born on July 19, 1878, at Cannelton, Ind. He was graduated in medicine from Vanderbilt University, and after a short period of practice in Evansville, Ind., entered

the x-ray equipment business in the capacity of a salesman, in 1905. From that time until his death he was continuously associated with the industry. His career thus paralleled the development of radiology from its early days to its present position as one of the great medical specialties.

Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

PRINCIPLES IN ROENTGEN STUDY OF THE CHEST. By WILLIAM SNOW, M.D., Director of Radiology, Bronx Hospital; Roentgenologist-in-charge, Harlem Hospital, New York City. A volume of 414 pages, with 508 illustrations. Published by Charles C Thomas, Springfield, Ill., 1946. Price $10.00.

A HANDBOOK OF RADIOGRAPHY. By JOHN A. ROSS, M.A. (Camb.) M.R.C.S. (Eng.), L.R.C.P. (Lond.), D.M.R.E. (L'pool), Visiting Radiologist, Alder Hey Children's Hospital, Liverpool; Hon. Radiologist, Warrington Infirmary, Warrington; Radiologist, General Hospital, Warrington; Hon. Radiologist, The St. Helens Hospital, St. Helens, Lancs.; Clinical Assistant, X-Ray Department, Royal United Hospital, Liverpool; Assistant Lecturer in Radiology, University of Liverpool. A volume of 165 pages with 92 illustrations. Published by H. K. Lewis & Co., Ltd., London, 2nd ed., 1946. Price 10/6d net.

Book Reviews

THE CHEST. A HANDBOOK OF ROENTGEN DIAGNOSIS. BY LEO G. RIGLER, M.D., Professor and Chief, Department of Radiology, University of Minnesota. A volume of 352 pages, with 338 illustrations. Published by The Year Book Publishers, Chicago, 1946. Price $6.50.

The "atlas plan" of presentation is particularly well adapted to roentgenologic treatises and the Year Book Publishers have done well to employ it in their excellent series of Handbooks on Roentgen Diagnosis. The volume on *The Chest*, the fifth in the series, follows the plan of its predecessors—a brief description of the salient points of roentgen examination and diagnosis for the conditions under consideration, followed and illuminated by a series of plates with accompanying descriptions. The illustrations, for the most part from the author's own files, are excellent and appear to have lost little in reproduction.

Methods of roentgenographic and fluoroscopic examination are described in a preliminary chapter, and photofluorograms are reproduced for comparison with standard films. A brief discussion of the indications for body-section roentgenography is also included, but the author has omitted details of the technic as too elaborate for a handbook of this type.

The second of the three main divisions of the book is devoted to the normal chest, the anatomic variations which may be expected, the bronchographic findings, and the physiology of the respiratory tract. An interesting feature is the diagrammatic representation of the various anatomic structures superimposed upon postero-anterior and lateral films of the normal thorax.

The bulk of the book, as would be expected, is devoted to the diseases of the chest, taking up in order the lungs and bronchi, mediastinum, and pleura.

Dr. Rigler's wide experience as a teacher is reflected in the many helpful suggestions which he has included, as well as in his clear and succinct presentation of facts. The book will have a great usefulness in the hands of the student and practitioner as well as in the roentgenologic laboratory.

THE 1946 YEAR BOOK OF RADIOLOGY, July, 1945–June, 1946. Diagnosis, edited by CHARLES A. WATERS, M.D., Assistant Professor of Roentgenology, Johns Hopkins University School of Medicine; Associate Editor, WHITMER B. FIROR, M.D., Instructor in Roentgenology, Johns Hopkins University School of Medicine. Therapeutics, edited by IRA I. KAPLAN, M.D., Director, Radiation Therapy Department, Bellevue Hospital, New York City; Clinical Professor of Surgery New York University Medical College; Associate Editor, SIDNEY RUBENFELD, M.D., Visiting Radiation Therapist, Bellevue Hospital. A volume of 463 pages, with 408 illustrations. Published by The Year Book Publishers, Inc., Chicago, Ill., Price $5.50.

The *Year Book of Radiology* has become so much a part of the radiological literature of America that a review of the latest volume seems almost superfluous. The present issue, as we are reminded in the introduction, is the first "to be compiled, edited and published during the Atomic Age," but the editors have wisely resisted any temptation to stray too far afield from the realm of medical radiology.

The volume covers chiefly the period between July 1945 and June 1946, but happily there have been included some earlier papers from the foreign literature not previously available. It is well to have some of the gaps created by the conditions of world conflict thus filled. While the material is presented largely in the form of abstracts, these are so classified and arranged that the effect is that of a continuous review presented under appropriate headings. The abstracts themselves are comprehensive, though concise, and are well illustrated by excellent reproductions of many of the original cuts. It is gratifying to see that each picture carries in its legend adequate acknowledgment of the source. Brief but pointed editorial comments throughout the work enhance its value.

Dr. Charles A. Waters and Dr. Whitmer B. Firor continue to edit the section on Diagnosis, while Dr. Ira I. Kaplan is joined by Dr. Sidney Rubenfeld in editing the section on Radiotherapeutics. All are to be congratulated on maintaining the high standard of excellence that has been set by the earlier volumes in the series.

MONGOLISM AND CRETINISM. A STUDY OF THE CLINICAL MANIFESTATIONS AND THE GENERAL PATHOLOGY OF PITUITARY AND THYROID DEFICIENCY. BY CLEMENS E. BENDA, M.D., Director, Wallace Research Laboratory for the Study of Mental Deficiency, Wrentham, Mass.; Instructor in Neuropathology, Harvard Medical School; Assistant in Psychiatry, Massachusetts General Hospital; Lecturer, Postgraduate Seminar, Massachusetts Department of Mental Health. A volume of 310 pages, with 101 illustrations. Published by Grune & Stratton, New York, 1946. Price $6.50.

The astounding incidence of mongolism in the United States, placing its blight on six thousand newborn infants annually and multiplying its misery through six thousand families, is indicative of the need of a thorough study of this problem. Dr. Benda's timely book is a scholarly milestone on the road to a fuller understanding of the condition.

The clinical picture of the disease is reviewed in detail, and the occurrence in both infants of four pairs of fraternal dizygotic twins is described, added evidence that the maternal state of health has a direct bearing on the offspring, as opposed to an inheritance factor. One chapter is devoted to the roentgenologic aspects of mongolism and cretinism. Roentgen studies of the carpal centers, indicating low thyroid function, and of the hand, showing the pathologic middle phalanx of the little finger, are presented, and the x-ray characteristics of the mongoloid and cretin skull are discussed. Considerable space is devoted to the physiology and clinical interpretation of the maternal state during pregnancy, a field in which the next great advances will probably be made. An important chapter is included on prevention, in relation to maternal age, maternal exhaustion, tendency to abortion, periods of sterility, and actual disease. Careful directions regarding treatment of the child are included, with a discussion of pituitary and thyroid preparations. The book is a library of facts about mongolism, relating them in a comparative way to cretinism.

RADIOLOGICAL SOCIETIES OF NORTH AMERICA

Editor's Note.—Will secretaries of societies please cooperate by sending information to the editor.

UNITED STATES

Radiological Society of North America.—Secretary, D. S. Childs, M.D., 607 Medical Arts Bldg., Syracuse 2, N.Y.

American Roentgen Ray Society.—Secretary, Harold Dabney Kerr, M.D., Iowa City, Iowa.

American College of Radiology.—Secretary, Mac F. Cahal, 20 N. Wacker Dr., Chicago 6, Ill.

Section on Radiology, A. M. A.—Secretary, U. V. Portmann, M.D., Cleveland Clinic, Cleveland 6, Ohio.

ALABAMA

Alabama Radiological Society.—Secy.-Treasurer, John Day Peake, M.D., Mobile Infirmary, Mobile.

ARKANSAS

Arkansas Radiological Society.—Secretary, Fred Hames, M.D., Pine Bluff. Meets every three months and annually at meeting of State Medical Society.

CALIFORNIA

California Medical Association, Section on Radiology.—Secretary, D. R. MacColl, M.D., 2007 Wilshire Blvd., Los Angeles 5.

Los Angeles County Medical Association, Radiological Section.—Secretary, Roy W. Johnson, M.D., 1407 South Hope St., Los Angeles. Meets second Wednesday of each month at County Society Building.

Pacific Roentgen Society.—Secretary, L. Henry Garland, M.D., 450 Sutter St., San Francisco 8. Meets annually with California Medical Association.

San Diego Roentgen Society.—Secretary, R. F. Niehaus, M.D., 1831 Fourth Ave., San Diego, Calif. Meets first Wednesday of each month.

San Francisco Radiological Society.—Secretary, Joseph Levitin, M.D., 516 Sutter St., San Francisco 2. Meets monthly on the third Thursday at 7:45 P.M., first six months of the year in Lane Hall, Stanford University Hospital, and second six months in Toland Hall, University of California Hospital.

COLORADO

Denver Radiological Club.—Secretary, Washington C. Huyler, M.D., Mercy Hospital, Denver 6. Meets third Friday of each month, Colorado School of Medicine.

CONNECTICUT

Connecticut State Medical Society, Section on Radiology.—Secretary, Robert M. Lowman, M.D., Grace-New Haven Hospital, Grace Unit, New Haven. Meetings bimonthly, second Thursday.

FLORIDA

Florida Radiological Society.—Secy.-Treasurer, Maxey Dell, Jr., M.D., 333 West Main St., S., Gainesville.

GEORGIA

Georgia Radiological Society.—Secretary-Treasurer, James J. Clark, M.D., 478 Peachtree St., N. E., Atlanta 3. Meets in November and at the annual meeting of State Medical Association.

ILLINOIS

Chicago Roentgen Society.—Secretary, T. J. Wachowski, M.D., 310 Ellis Ave., Wheaton. Meets at the Palmer House, second Thursday of October, November, January, February, March, and April.

Illinois Radiological Society.—Secretary-Treasurer, William DeHollander, M.D., St. Johns' Hospital, Springfield. Meetings quarterly by announcement.

Illinois State Medical Society, Section on Radiology.—Secretary, Frank S. Hussey, M.D., 250 East Superior St., Chicago 11.

INDIANA

The Indiana Roentgen Society.—Secretary-Treasurer, J. A. Campbell, M.D., Indiana University Hospitals, Indianapolis 7. Annual meeting in May.

IOWA

The Iowa X-ray Club.—Secretary, Arthur W. Erskine, M.D., 326 Higley Building, Cedar Rapids. Meets during annual session of Iowa State Medical Society.

KENTUCKY

Kentucky Radiological Society.—Secy.-Treasurer, Sydney E. Johnson, M.D., 101 W. Chestnut St., Louisville.

LOUISIANA

Louisiana Radiological Society.—Secretary-Treasurer, Johnson R. Anderson, M.D., No. Louisiana Sanitarium, Shreveport. Meets with State Medical Society.

Orleans Parish Radiological Society.—Secretary, Joseph V. Schlosser, M.D., Charity Hospital of Louisiana, New Orleans 13. Meets first Tuesday of each month.

Shreveport Radiological Club.—Secretary, Oscar O. Jones, M.D., 2622 Greenwood Road. Meets monthly September to May, third Wednesday, 7:30 P.M.

MARYLAND

Baltimore City Medical Society, Radiological Section.—Secretary, Charles N. Davidson, M.D., 101 West Read St., Baltimore 1.

MICHIGAN

Detroit X-ray and Radium Society.—Secretary-Treasurer, E. R. Witwer, M.D., Harper Hospital, Detroit 1. Meetings first Thursday of each month from October to May, at Wayne County Medical Society club rooms.

MINNESOTA

Minnesota Radiological Society.—Secretary, A. T. Stenstrom, M.D., Minneapolis General Hospital, Minneapolis 26. Meetings quarterly.

MISSOURI

Radiological Society of Greater Kansas City.—Secretary, John W. Walker, M.D., 306 E. 12th St., Kansas City, Mo. Meetings last Friday of each month.

St. Louis Society of Radiologists.—Secretary, Edwin C. Ernst, M.D., 100 Beaumont Medical Bldg. Meets on fourth Wednesday of each month, October to May.

NEBRASKA

Nebraska Radiological Society.—Secretary-Treasurer, Donald H. Breit, M.D., University of Nebraska Hospital, Omaha 5. Meetings third Wednesday of each month at 6 P.M. in either Omaha or Lincoln.

NEW ENGLAND

New England Roentgen Ray Society.—Secretary-Treasurer, George Levene M.D. Massachusetts Memorial

Hospitals, Boston, Mass. Meets monthly on third Friday at Boston Medical Library.

NEW HAMPSHIRE

New Hampshire Roentgen Society.—Secretary, Albert C. Johnston, M.D., Elliot Community Hospital, Keene.

NEW JERSEY

Radiological Society of New Jersey.—Secretary, W. H. Seward, M.D., Orange Memorial Hospital, Orange. Meetings at Atlantic City at time of State Medical Society and midwinter in Newark as called.

NEW YORK

Associated Radiologists of New York, Inc.—Secretary, William J. Francis, M.D., East Rockaway, L. I.

Brooklyn Roentgen Ray Society.—Secretary-Treasurer, Abraham H. Levy, M.D., 1354 Carroll St., Bklyn. 13. Meets fourth Tuesday of every month, October to April.

Buffalo Radiological Society.—Secretary-Treasurer, Mario C. Gian, M.D., 610 Niagara St., Buffalo 1. Meetings second Monday evening each month, October to May, inclusive.

Central New York Roentgen Society.—Secretary-Treasurer, Carlton F. Potter, M.D., 425 Waverly Ave., Syracuse 10. Meetings in January, May, and October.

Long Island Radiological Society.—Secretary, Marcus Wiener, M.D., 1430 48th St., Brooklyn 19. Meetings fourth Thursday evening each month at Kings County Medical Bldg.

New York Roentgen Society.—Secretary, Wm. Snow, M.D., 941 Park Ave., New York 28.

Rochester Roentgen-Ray Society.—Secretary, Murray P. George, M.D., 260 Crittenden Blvd., Rochester 7. Meets at Strong Memorial Hospital, third Monday, September through May.

NORTH CAROLINA

Radiological Society of North Carolina.—Secretary-Treasurer, James E. Hemphill, M.D., Professional Bldg., Charlotte 2. Meets in May and October.

NORTH DAKOTA

North Dakota Radiological Society.—Secretary, Charles Heilman, M.D., 1338 Second St., N., Fargo.

OHIO

Ohio Radiological Society.—Secretary, Henry Snow, M.D., 1061 Reibold Bldg., Dayton 2. Next meeting at annual meeting of the Ohio State Medical Association.

Central Ohio Radiological Society.—Secretary, Hugh A. Baldwin, 347 E. State St., Columbus.

Cleveland Radiological Society.—Secretary-Treasurer, Carroll C. Dundon, M.D., 11311 Shaker Blvd., Cleveland 4. Meetings at 6:30 P.M. on fourth Monday of each month from October to April, inclusive.

Radiological Society of the Academy of Medicine (Cincinnati Roentgenologists).—*Secretary-Treasurer,* Samuel Brown, M.D., 707 Race St., Cincinnati 2. Meetings held third Tuesday of each month.

PENNSYLVANIA

Pennsylvania Radiological Society.—Secretary-Treasurer, L. E. Wurster, M.D., 416 Pine St., Williamsport 8.

Philadelphia Roentgen Ray Society.—Secretary, Calvin L. Stewart, M.D., Jefferson Hospital, Philadelphia 7. Meets first Thursday of each month at 8:00 P.M., from October to May in Thomson Hall, 21 S. 22d St.

Pittsburgh Roentgen Society.—Secretary-Treasurer, Lester M. J. Freedman, M.D., 415 Highland Bldg., Pittsburgh 6. Meets second Wednesday of each month at 6:30 P.M., October to May, inclusive.

ROCKY MOUNTAIN STATES

Rocky Mountain Radiological Society.—Secretary, A. M. Popma, M.D., 220 N. First St., Boise, Idaho.

SOUTH CAROLINA

South Carolina X-ray Society.—Secretary-Treasurer, Robert B. Taft, M.D., 103 Rutledge Ave., Charleston 16.

TENNESSEE

Memphis Roentgen Club.—Meetings second Tuesday of each month at University Center.

Tennessee Radiological Society.—Secretary-Treasurer, J. Marsh Frére, M.D., 707 Walnut St., Chattanooga. Meets annually with State Medical Society in April.

TEXAS

Dallas-Fort Worth Roentgen Study Club.—Secretary, X. R. Hyde, M.D., Medical Arts Bldg., Fort Worth 2. Meetings on third Monday of each month, in Dallas in the odd months and in Fort Worth in the even months.

Texas Radiological Society.—Secretary-Treasurer, R. P. O'Bannon, M.D., 650 Fifth Ave., Fort Worth 4.

UTAH

Utah State Radiological Society.—Secretary-Treasurer, M. Lowry Allen, M.D., Judge Bldg., Salt Lake City 1. Meets third Wednesday, January, March, May, September, November.

VIRGINIA

Virginia Radiological Society.—Secretary, E. Latan Flanagan, M.D., 215 Medical Arts Bldg., Richmond 19.

WASHINGTON

Washington State Radiological Society.—Secretary-Treasurer, Frederic E. Templeton, M.D., 414 Cobb Bldg., Seattle 1. Meetings fourth Monday of each month, October through May, at College Club, Seattle.

WISCONSIN

Milwaukee Roentgen Ray Society.—Secretary-Treasurer, C. A. H. Fortier, M.D., 231 W. Wisconsin Ave., Milwaukee 3. Meets monthly on second Monday at the University Club.

Radiological Section of the Wisconsin State Medical Society.—Secretary, S. R. Beatty, M.D., 185 Hazel St., Oshkosh. Two-day meeting in May and one day at annual meeting of State Medical Society in September.

University of Wisconsin Radiological Conference.—Meets first and third Thursdays 4 to 5 P.M., September to May, inclusive, Room 301, Service Memorial Institute, 426 N. Charter St., Madison 6.

CANADA

Canadian Association of Radiologists.—Honorary Secretary-Treasurer, E. M. Crawford, M.D., 2100 Marlowe Ave., Montreal 28, Quebec.

La Société Canadienne-Française d'Electrologie et de Radiologie Médicales.—General Secretary, Origéne Dufresne, M.D., Institut du Radium, Montreal. Meets on third Saturday of each month.

CUBA

Sociedad de Radiología y Fisioterapia de Cuba.—Offices in Hospital Mercedes, Havana. Meets monthly.

ABSTRACTS OF CURRENT LITERATURE

ROENTGEN DIAGNOSIS

The Head and Neck

The Chest

The Digestive System

The Musculoskeletal System

The Blood Vessels

The Genito-Urinary System

Apparatus

RADIOTHERAPY

EFFECTS OF RADIATION

ROENTGEN DIAGNOSIS

THE HEAD AND NECK

Lipoma of the Corpus Callosum. A Clinicopathologic Study. Carl F. List, John F. Holt, and Marjorie Everett. Am. J. Roentgenol. **55:** 125–134, February 1946.

Two cases of lipoma of the corpus callosum are recorded, bringing the total number in the literature to 30. Anatomically these lipomas are encapsulated tumors lying on the dorsal surface of the corpus callosum beneath the leptomeninges, usually occupying the anterior portion although they may extend posteriorly. The size and consequently the normal structures involved vary. The anterior cerebral arteries are incorporated in the tumors. Histologically the lesion is typical of lipoma found elsewhere in the body. No neural elements appear, but calcification either as psammoma bodies or islands of true bone is present. Associated central nervous system or skeletal anomalies are common. Theories as to pathogenesis vary, but the authors consider the explanation that the lipoma is a tumor-like malformation arising from primitve membranes of the brain as the most acceptable. There is no predilection for sex or age, and there is no diagnostic clinical syndrome. Roentgen diagnosis is, however, sometimes possible, though little stress has been placed on this in the literature.

Roentgenologically, the diagnosis may be made on the basis of a well circumscribed area of radiolucency in the mid-line in the frontal region, calcification, which may outline the tumor in plain skull films, encephalographic findings of wide separation of the lateral ventricles anteriorly and concave mesial margins of the lateral ventricles.

Surgery is contraindicated because of the close relationship of the anterior cerebral arteries.

ELIZABETH A. CLARK, M.D.

Injection of Oxygen into Tenon's Capsule. Harold G. Scheie and Philip J. Hodes. Arch. Ophth. **35:** 13–14, January 1946.

The injection of a contrast medium into Tenon's capsule (Spackman: Am. J. Ophth. **15:** 1007, 1932) is an invaluable procedure for the roentgenographic localization of intraocular foreign bodies. In the authors' experience oxygen is superior to air and carbon dioxide for this purpose. It produces excellent visualization of the globe; it is absorbed slowly enough to permit reexamination when necessary, yet fast enough to avoid the risk of vitreous escaping at operation. Spackman's technic for injecting air into Tenon's capsule was used and is described again here. The authors found their results with this procedure more accurate than with the stereoscopic method of Griffin, Gianturco, and Goldberg (Radiology **40:** 371, 1943), in which a semi-opaque artificial eye is used to outline the globe.

THE CHEST

Chest Photoroentgenography in Army Physical Examinations. Israel A. Schiller. Am. Rev. Tuberc. **53:** 103–114, February 1946.

The results of routine radiographic examination of the chests of 40,283 men examined at the Buffalo Induction Station are presented. Eight hundred and fifty-six (2.12 per cent) were rejected because of pulmonary disease, and in approximately 75 per cent of these, the disease was tuberculosis. The highest rejection rate occurred among the older men, due to a greater prevalence of arrested tuberculosis.

One of the valuable contributions of the Army x-ray program has been the detection of non-tuberculous pulmonary disease. There were 224 rejections for various chest lesions other than tuberculosis. Bronchiectasis was the most frequent (51 cases.) Other significant findings were pneumonitis, 45 cases; disease of the pleura, 44 cases; pulmonary fibrosis and emphysema, 32 cases; mediastinal lymphadenopathy, 16 cases; pneumoconiosis, 11 cases. L. W. PAUL, M.D.

Silent and Masquerading Intrathoracic Lesions. Importance of Proper Identification of Lesions Discovered During X-Ray Surveys. Richard H. Overholt and Norman J. Wilson. New England J. Med. **234:** 169–180, Feb. 7, 1946.

With the advent of mass roentgenologic chest surveys, many lesions are discovered which are not necessarily identified but should be studied and defined for proper treatment.

In tuberculosis, the roentgenogram defines the extent of the disease, but clinical and other laboratory examinations are necessary to demonstrate activity of the process. Examination of sputum, and gastric washings, cultures, and guinea-pig inoculation are all sometimes necessary for determination of activity. Stereoscopic x-ray films, spot films, and fluoroscopy are often required. In the early period of the disease, chest films every one to two weeks are necessary to show spread.

Carcinoma of the lung may be first discovered during a chest survey. It is a disease of middle life but may occur at any age. It is seen about four times as frequently in the male as in the female. In very early cases there may be no change shown on the film. Later the bronchus is blocked and localized emphysema develops. As the disease progresses, atelectasis will occur. Many of the changes depend upon the location of the tumor. Bronchoscopy is a valuable procedure, especially for securing a biopsy. Aspiration biopsy should be done with caution. Exploratory thoracotomy is coming into more general use and approval with the lowering of mortality rates and advances in technic.

Mediastinal tumors have been shown to be more frequent than previously suspected. Some of these growths are benign, others malignant. Irradiation will control the lymphomata temporarily. Other tumors can be removed surgically.

The authors advise that, once a chest lesion is discovered, every means be used to identify it. Delay or watchful waiting should never be practised.

JOHN B. MCANENY, M.D.

A Tuberculosis Survey in New Orleans. Chester A. Stewart. New Orleans M. & S. J. **98:** 330–334, January 1946.

Between October 1943 and July 1945 more than 20,000 persons in New Orleans and vicinity were examined for tuberculosis by photofluorography; 8,571 of this number received in addition the Mantoux test and it is with this group that the present paper deals. Tuberculin testing of persons representing the lower socio-

economic level disclosed that throughout the entire life span tuberculosis is much more prevalent among the poor colored population than among the poor white population. The difference between the two groups roughly parallels that existing between their respective current tuberculosis death rates (in 1944, 103.6 for the colored race and 35.2 for the white race). The photofluorographic study resulted in the discovery of pulmonary infiltrations in 103 patients. In general the study demonstrated that photofluorography is of value in detecting pulmonary lesions, but subsequent investigations are needed for accuracy in diagnosis.

Cardiac and aortic enlargement were found to be more prevalent in the colored than in the white patients, a difference which is attributed to the relatively higher incidence of syphilis in the Negro.

A Note on the Occurrence of Silicosis in Bituminous Coal Miners. Maurice J. Small. West Virginia M. J. **42:** 6, January 1946.

The author calls attention to the not generally known fact that silicosis occurs rather frequently in miners operating coal cars in bituminous mines as well as among anthracite miners and granite and sandstone cutters. Ten such cases, with typical clinical and roentgen findings, have been encountered during the past four years; two of these patients developed silicotuberculosis.

All of the men in this series operated the cars that haul coal from the pit to the surface. The grade is quite steep in this ascent and sand is sprinkled on the wheels to increase traction; this is ground into a heavy cloud of dust of sufficiently small size to cause silicosis. This hazard has been recognized by the coal companies and in recent years masks have been issued to the miners thus exposed.

A Health Survey of Pipe Covering Operations in Constructing Naval Vessels. Walter E. Fleischer, Frederick J. Viles, Jr., Robert L. Gade, and Philip Drinker. J. Indust. Hyg. & Toxicol. **28:** 9–16, January 1946.

An industrial health inspection of an important U. S. Navy Contract Yard indicated that dustiness from miscellaneous pipe-covering operations was considerable and that a few of the employees had what appeared to be an asbestosis. The important ingredient of pipe-covering material used in U. S. Navy vessels is amosite, a magnesium iron silicate of variable composition. Since the pipe coverer may rotate between shop and ship and from small to large ship compartments, with a wide variation in dust exposure, conclusions drawn from other asbestos industries cannot be applied. Examinations were made of the working conditions, including dust counts of the air breathed and microscopic and chemical analysis of the dust itself, at two Government Navy Yards and two Navy Contract Yards. X-ray examination of the chests of 1,074 workers at the four yards revealed only 3 workers with asbestosis; 2 of these men had been pipe coverers for more than twenty years, and the third had worked in the asbestos industry for twenty-three years before coming to work in the yard. From this study it is concluded that pipe covering is not a dangerous occupation. The most dusty operations, however, should be equipped with exhaust ventilation to keep the total dust concentration low.

Reaction Following Bronchography with Iodized Oil. George S. Mahon. J. A. M. A. **130:** 194–197, Jan. 26, 1946.

A brief review of the literature on reactions to lipiodol when used in bronchography is given. Only 19 cases could be found with severe reactions (8 with fatal termination), but the number of bronchographic examinations from which this group originated is not known.

The author presents in detail the history (including autopsy findings) of a patient who died following bronchography with lipiodol. The examination was made at 9:00 A.M.; at 10:30 a severe generalized convulsion occurred, and death ensued almost immediately, 75 minutes after introduction of the contrast medium. The autopsy findings suggested an allergic asthma, though in the absence of clinical symptoms no inquiries had been made into this phase of the history. The explanation given for the death is that the tracheobronchial tree was allergically prepared to act as a shock organ and reacted to some constituent of the lipiodol, presumably iodine. Death resulted from bronchial obstruction from thick mucus, with massive pulmonary collapse and subsequent asphyxia.

[EDITORIAL NOTE: In a communication in the Correspondence columns of the J. A. M. A. (**130:** 599, March 2, 1946) Dr. George L. Waldbott differs with Mahon as to the cause of death in this case. He considers the interval between the instillation of the lipiodol and the development of the "reaction" too long to attribute it to an allergic factor. "Since the pathologic condition described was typical of death from allergic asthma and since death was due to obstruction of the bronchi by mucous plugs, the preexisting asthma and bronchiectasis should be held solely responsible."

Waldbott draws two lessons from the case: (1) If an asthmatic patient has much mucus in the bronchial tree, a lipiodol injection should either be avoided or preceded by bronchoscopic aspiration of mucus. (2) When an accident of this kind occurs, the first measure should be the immediate insertion of a bronchoscope and the aspiration of the obstructing material.]

R. S. MACINTYRE, M.D.
(University of Michigan)

Primary Mesothelioma (Endothelioma) of the Pleura. Case Report. Arnold D. Piatt. Am. J. Roentgenol. **55:** 173–180, February 1946.

The incidence of primary mesothelioma of the pleura is estimated at 1.1 per thousand necropsies. The author's patient was a 33-year-old white woman who was observed over a period of two years. The presenting symptom was persistent chest pain, associated with loss of energy and dry cough. At the time of the first examination, the chest roentgenogram was interpreted as serofibrinous pleurisy over the left diaphragm; fluoroscopically there was limitation of motion of the left diaphragm. Fifteen months later a second roentgen examination showed enlargement of the cardiac silhouette, pleural effusion obscuring the left lower lung field, and hilar and central root branch thickening on both sides, extending toward the bases, as well as thickening of the right upper interlobar septum. Six weeks after this a dense mass was demonstrated roentgenoscopically and kymographically in the left oblique position, arising from the region of the lower left heart silhouette and in close relation to the cardiac shadow.

Pleural mesothelioma was suggested at this time but only as a remote possibility, bronchiogenic carcinoma being considered a more probable diagnosis. This opinion was strengthened a month later, when severe pain developed in the pelvis and lower spine and metastatic infiltration was demonstrated in the pelvic bones.

Palliative roentgen therapy was given to the chest and the pelvis, but relief of pain was only transient. Repeated thoracentesis was done, but no malignant cells were found in the aspirated fluid. Some difficulty was experienced in forcing the aspirating needle into the pleural space, but the diagnostic significance of this was not appreciated. Terminally blood appeared in the aspirated fluid and dyspnea became severe.

Autopsy showed primary mesothelioma (endothelioma) of the left pleura with an old encapsulated pleural serofibrinous-hemorrhagic exudate; complete compression atelectasis of the left lung; metastases to the pericardium, the right visceral pleura, both lungs, the mediastinal lymph nodes, and the eighth left rib and pelvis.

The clinical and roentgenological manifestations of this type of tumor are confusing, and the effect of radiation therapy is open to some question. In the reported case, no positive evidence of radiosensitivity could be demonstrated microscopically. However, dosage may have been inadequate because of the other factors involved. On the other hand, the possibility that a stimulating dose may have been given to the neoplasm must be kept in mind. ELIZABETH A. CLARK, M.D.

Experience in the Localization of Thoracic Foreign Bodies. Benjamin Burbank, Thomas H. Burford, Paul C. Samson, and Sidney Mesirow. J. Thoracic Surg. **15:** 64–75, February 1946.

An x-ray machine capable of making chest films and a fluoroscope are all the equipment necessary for the method described by the authors for the localization of foreign bodies in the chest. Postero-anterior and lateral films of the chest are made first and the lung fields are divided by vertical lines into three sectors, each one of which is roughly one-third of the lung diameter. In the postero-anterior view each lung field will be divided into these three sectors, with the middle of the mediastinum as the dividing line. The sectors are labeled *A*, *B*, and *C* in the postero-anterior view and *A'*, *B'*, and *C'* in the lateral view. If a foreign body is in the middle sector in both views (i.e., in *B* and *B'*), it must be in the lung. In all other combinations of sectors more study is necessary to decide whether the foreign body is intrapulmonary or extrapulmonary, or in the mediastinum. Usually fluoroscopy is the next step, with spot films made in the oblique projection, which demonstrates the closest approximation of the foreign body to the chest wall. If the localization is still in doubt, a diagnostic pneumothorax may be done. In cases with a foreign body near the diaphragm, it may be necessary to do a pneumoperitoneum, followed by upright films and fluoroscopy and spot films.

Several case reports with reproductions of the films are included to illustrate foreign bodies in different positions. The main objective in all cases is to determine whether the foreign body is in the chest wall, pleural cavity, lung, mediastinum, or below the diaphragm. More accurate localization—centimeters distance from any particular point—is not considered necessary. HAROLD O. PETERSON, M.D.

THE DIGESTIVE SYSTEM

Abdominal Lymphogranulomatosis. Lloyd F. Craver and Julian B. Herrmann. Am. J. Roentgenol. **55:** 165–172, February 1946.

The involvement of the gastro-intestinal tract by Hodgkin's disease may be classified as primary, secondary, and extrinsic. Primary lymphogranulomatosis may involve any part of the gastro-intestinal tract or several segments concomitantly. It is most frequent in the stomach, where it produces a filling defect usually interpreted as due to cancer or ulcer. Superficial lymphadenopathy is seldom present. In the secondary group the gastro-intestinal lesions are part of a generalized process. Symptoms may be absent and the involvement of the digestive tract may be discovered only on postmortem examination. In the third group of cases there is no clinical, roentgenologic, or gastroscopic evidence of intrinsic gastro-intestinal involvement, but symptoms are due to extrinsic pressure by enlarged abdominal lymph nodes.

Of 406 patients with Hodgkin's disease (proved by biopsy) seen at Memorial Hospital between 1932 and 1942, 52 (12.8 per cent) had gastro-intestinal symptoms. Of these, 7 were found (at autopsy in 6 cases, and on gastroscopy in 1) to have specific gastro-intestinal lesions of the secondary type, while in 45 the complaints were presumably of extrinsic origin. Roentgen studies of the gastro-intestinal tract were carried out in 33 patients, or 63 per cent of those with gastro-intestinal symptoms. In approximately 50 per cent no abnormality was discovered.

It was found that patients in whom gastro-intestinal symptoms developed during the course of the disease had a life expectancy of one year and two months longer than the average life expectancy for all cases of Hodgkin's disease. For those patients whose earliest complaints were gastro-intestinal, however, the average duration of the disease was only nine and one-half months. It has been suggested that since the abdominal organs are able to adjust themselves to slowly growing extrinsic masses, symptoms from Hodgkin's involvement of the retroperitoneal lymph nodes do not occur until relatively late in the course of the disease.

Therapy for the primary type of abdominal lymphogranulomatosis is surgical, and survivals of six to eight years have been recorded. Radiation therapy for the secondary and extrinsic types is palliative, but does not increase the life expectancy.

ELIZABETH A. CLARK, M.D.

A Roentgenologic and Gastroscopic Study of Gastric Disease. William E. Ricketts and H. Marvin Pollard. Gastroenterology **6:** 1–6, January 1946.

An analysis is made of 1,297 patients who were studied both by x-ray and gastroscopy. Patients in whom the diagnosis was the same by the two methods (760, or 50.6 per cent), those with lesions of the duodenum recognizable only by roentgen examination, and those with previous gastric surgery were excluded from the comparative study.

In 355 patients, the gastroscopic and roentgen diagnoses disagreed. Gastroscopy failed to reveal the lesions seen roentgenologically in 46 cases (benign ulcer, 22; carcinoma, 21; benign polyposis, 2; gastric diverticulum, 1). Conversely, positive gastroscopic and negative x-ray evidence was obtained in 309 cases

(chronic gastritis, 269; benign ulcer, 26; carcinoma, 10; benign polyp, 4). In 3 cases an incorrect diagnosis of carcinoma was made by both gastroscopy and x-ray. The lesion in each instance was a severe inflammation of the lower stomach.

Pitfalls in Localizing Intestinal Obstruction with the Scout Film. George Vash, Karl J. Myers, and Hu C. Myers. West Virginia M. J. **42:** 7–9, January 1946.

The authors review the literature concerning radiography of the abdomen for diagnosing intestinal obstruction and report a case. Their patient was a 57-year-old man with pain in the abdomen, bloating, nausea, and vomiting. These symptoms had been present for two weeks and bowel movements ceased four days before hospital admission. The abdomen was distended and slightly tender throughout, and several nodules of varying size were present in the rectum. A scout film, taken with the patient erect and the central ray horizontal, showed distention of the loops of the jejunum and ileum, with no gas in the colon, suggesting a small bowel obstruction. Several attempts to pass a Miller-Abbott tube beyond the pylorus failed completely. Since the patient's general condition did not permit exploration, an ileostomy was done. Only a small amount of fluid and gas was obtained from the small intestine, and during the following day it became clear that the distention had been only partly relieved. Death occurred on the sixth postoperative day. Autopsy showed the large bowel completely filled with soft fecal material and the small bowel moderately distended. At the rectosigmoid junction was an annular mass which had so constricted the lumen that only a narrow slit remained. Histologic study revealed a papillary adenocarcinoma.

The erroneous x-ray findings which led to the decision to do an ileostomy can be explained only by assuming that the obstruction was not quite complete. All the gas of the colon evidently found its way through the narrow slit-like canal which remained at the site of the neoplasm. The solid particles of fecal material could not pass through this tiny opening and gradually filled the entire colon proximal to the carcinoma. This portion of colon, impacted with feces, acted as a closed loop and caused a secondary small bowel obstruction. The authors believe that the case proves that accurate localization of an intestinal obstruction with a scout film is not always possible.

J. E. WHITELEATHER, M.D.

Tuberculous Ulcerative Colitis or Ulcerative Colitis with Superimposed Tuberculous Infection. A Case Report. Paul M. Glenn and Hilton S. Read. Gastroenterology **6:** 9–20, January 1946.

The authors report a case of ulcerative colitis with an ischiorectal abscess from which tubercle bacilli were isolated, but with no active pulmonary disease demonstrable roentgenologically or at autopsy. Whether the case represents a primary intestinal tuberculous infection or a superimposed tuberculous infection is undetermined. Either occurrence is unusual.

A barium enema study demonstrated features characteristic of advanced chronic ulcerative colitis, while examination of the upper intestinal tract showed a constricting lesion of the distal ileum and jejunal changes suggestive of a secondary deficiency state. Late in the course of the disease, acid-fast bacilli, believed to be *Myobacterium tuberculosis*, were found in cultures from a draining perianal sinus and in the feces. The tuberculin test was negative and examination of gastric washings on three occasions showed no acid-fast organisms.

The patient, a 22-year-old soldier, died after ninety-one days in the hospital. The principal autopsy findings were those of a non-specific chronic ulcerative colitis. A large abscess filled the left ischiorectal fossa. Cultures and smears from this abscess and from the peritoneal cavity yielded *Myobacterium tuberculosis*.

Massive Calcification of the Liver. Case Report with a Discussion of Its Etiology on the Basis of Alveolar Hydatid Disease. Norman Heilbrun and Andrew J. Klein. Am. J. Roentgenol. **55:** 189–192, February 1946.

Calcification within the liver parenchyma is an unusual roentgenographic finding. The most common cause is echinococcus or hydatid disease, usually of the unilocular type. In this form the mother cyst is encapsulated and the daughter cysts are produced by invagination of the germinal layer. Calcification may occur in the capsular tissues and is demonstrable in the roentgenogram as a smooth curvilinear shadow.

The author's case is representative of a less familiar form of the disease, the alveolar type, seen principally in Central Europe. In these cases the daughter cysts are produced by evagination, there is no limiting capsule, and infiltration of the organs of the host occurs as in the case of malignant growth. Death of the parasite may be followed by massive calcification.

The patient was a 32-year-old white soldier who had been born in Czechoslovakia and had lived there until he was 9 years old. Roentgenograms of the abdomen showed an irregularly calcified non-encapsulated mass measuring 12 cm., in the left lobe of the liver, and numerous similar but smaller calcifications in the right lobe. Although neither complement-fixation nor skin tests were positive for echinococcosis, other causes of calcification in the liver were excluded, and since the patient was known to have lived in an area where the disease is prevalent, the case is believed to represent calcification in alveolar hydatid disease. The negative immunologic tests are attributed to the complete death of the parasite, with loss of antigenic properties.

ELIZABETH A. CLARK, M.D.

THE MUSCULOSKELETAL SYSTEM

Skeletal and Pulmonary Metastases from Cancer of the Kidney, Prostate and Bladder. Jacob R. Freid. Am. J. Roentgenol. **55:** 153–164, February 1946.

The incidence of skeletal and pulmonary metastases in 203 cases of carcinoma of the kidney, prostate, and bladder was investigated. In almost all of the cases roentgenographic as well as autopsy material was available. Of 87 patients with carcinoma of the kidney, 45 per cent had skeletal metastases and 54 per cent had pulmonary or pleural metastases. Bone lesions, always destructive in character, were found to be either single or multiple and to have a predilection for the upper ends of the long bones near the nutrient vessels. In the chest, parenchymal lesions predominated, indicating the mode of spread as hematogenous.

Of the 60 patients with carcinoma of the prostate, 58 per cent had skeletal metastases, and in only 3 cases were these purely osteoclastic. The pelvis, spine, and

femur were most frequently involved, with the ribs, scapula, clavicles, humerus, and skull following in the order named. Of the prostatic group, 43 per cent had pulmonary involvement. A combination of pleural and parenchymal lesions was the most frequent finding, indicating the mode of spread as both hematogenous and lymphogenous.

Direct extension of carcinoma of the bladder (total 56 cases) to bone was found in 5 cases and true metastasis but once. Pulmonary lesions were found in 7 per cent of the series, and in these cases there was extension of the primary tumor to regional nodes.

Roentgen therapy, in dosages of 2,000 to 3,000 r, gave palliation of pain in the skeletal metastases. Decrease in the rapidity of fluid formation was obtained by irradiation of the pulmonary lesions, but otherwise there was little effect. ELIZABETH A. CLARK, M.D.

THE BLOOD VESSELS

Distention or Collapse of the Vena Cava. Radiologic Study. J. Duomarco, R. Rimini, and F. M. Predari. Rev. argent. de cardiol. **12:** 333–344, January-February 1946.

A roentgen study of the vena cava in dogs was made by rapid injection of a 40 per cent solution of sodium iodide. It was found that the state of distention or collapse of the thoracic vena cava does not depend on the existence of a negative thoracic pressure, but on the position of the animal, collapse occurring when the dog's head is up, in the vertical position, and distention when the head is down, in the vertical position. No appreciable changes in the form of the inferior vena cava were elicited by passing from one vertical position to the other, nor by heart stoppage, which suggests the existence of special conditions. These facts confirm previous manometric observations.

THE GENITO-URINARY SYSTEM

Case of Pyelitis and Cystitis Cystica. Lino J. Arduino. J. Urol. **55:** 149–152, February 1946.

The author describes a case of pyelitis cystica diagnosed by pyeloureterography and proved by biopsy. The patient has been treated with sulfathiazole and has improved symptomatically.

The theory of pathogenesis of this condition as formulated by von Brunn in 1893 is accepted as satisfactory by the author. von Brunn described downgrowing "epithelial sprouts" which formed "epithelial nests" in the submucosa. According to his view, the stalks of these nests become pinched off, they proliferate, their centers degenerate, and they reappear as cysts along the urinary tract. Etiological features include chronic infection, obstruction, carcinoma, etc.

Clinical diagnosis of pyelitis and cystitis cystica is a fairly recent development. The disease should be suspected with a history of chronic infection and hematuria. Characteristically the pyelogram shows filling defects of either the renal pelvis or the calices, dilatation of the ends of major calices, narrowing of the arms of the calices below, and cystic dilatation of the uretero-pelvic junction. The ureterogram shows typical mottling caused by non-opaque filling defects in the outline of the ureter. JAMES C. KATTERJOHN, M.D.

Angioma of the Kidney. Frank C. Hamm. J. Urol. **55:** 143–148, February 1946.

A 34-year-old soldier suffered from pain in the left renal area with radiation anterior and downward to the left testicle. Gross hematuria and fever were also present, but the latter was controlled by sulfadiazine. Cystoscopic examination overseas showed blood coming from the left ureter, but pyelograms were reported as being essentially negative. Pyelographic study after the patient's return to the United States revealed a small filling defect in the left upper calyx, simulating papilloma of the renal pelvis. The right kidney was small and poorly developed, suggesting previous infection. Because of possible insufficiency of the right kidney, a left heminephrectomy rather than a nephrectomy was performed. Pathologic studies revealed an angioma. Convalescence was relatively uneventful.

The author concludes that the only consistent symptom of angioma of the kidney is hematuria, which is usually intermittent and may produce colic. Though a preoperative diagnosis cannot be made with present methods, the diagnosis may be suspected in the presence of hematuria and a filling defect in the pyelogram in a subject under forty years of age. The absence of a tumor or the absence of x-ray evidence of enlargement of the kidney tends to support this suspicion.

FREDERICK A. BAVENDAM, M.D.

APPARATUS

First Practical Experiences with a Mobile Radiophotographic Unit in Switzerland. E. A. Zimmer. Schweiz. med. Wchnschr. **75:** 501, 1945.

The author describes the first photofluorographic unit used in Switzerland. The nature of the terrain necessitated a somewhat special construction, including a rather lighter cart than is usual and provision for horse rather than motor transportation. The electrical supply was obtained from local sources through a 30-ft. cable, although the voltage drop in the local lines was a source of embarrassment and sometimes necessitated increasing the exposure time. Development was accomplished by use of dressing-room space within the cart. The paper discusses at some length the administrative and technical aspects of obtaining satisfactory films, and also the use of fluoroscopy as a means of investigation. The author feels that while fluoroscopy is important in individual cases, films are more suitable for serial examinations.

LEWIS G. JACOBS, M.D.

RADIOTHERAPY

Treatment of Inoperable Carcinoma of the Breast with Irradiation. Charles L. Martin. Surgery **19:** 132–148, January 1946.

In spite of the good results obtained with radical surgery in early cases of cancer of the breast, less than one-fourth the patients entering cancer clinics today can hope for a surgical cure. Haagensen and Stout (Ann. Surg. **118:** 859, 1943), reporting on 640 cases treated by radical mastectomy, showed that 22.2 per cent of the total number could be classified as five-year cures, while the remaining 77.8 per cent required some form of palliative therapy. Data are presented by these same

writers upon which a choice between radical and palliative therapy may be based.

For palliative irradiation the author favors in general the implantation of weak radium needles as advocated by Keynes. A minimum of sloughing and fibrosis is produced, and both primary and secondary tumors in and about the breast are often completely eradicated. Methods of implanting the needles and calculating dosage have been described elsewhere (see Am. J. Roentgenol. **48:** 377, 1942).

The alveolar structures of the lungs are especially sensitive to x-rays. Extensive pulmonary fibrosis has resulted from doses of approximately 5.0 T.E.D., and in some instances the radiation reaching the lung amounted to only 2.5 T.E.D. A patient can survive with even an entire lung fibrosed, but elevation of the dosage above safe limits for the pulmonary structures frequently produces a radiation osteitis in the ribs, with pathological fractures. Palliative irradiation should be given with technics which reduce such sequelae to a minimum. In the author's clinic 15-cm. portals are treated with 2,100 to 2,400 r at the rate of 300 r daily.

Improvement has been reported in approximately 25 per cent of breast cancer patients treated by surgical castration, and similar good results have been obtained with irradiation castration. The method is most useful in the presence of bone metastases and should always be tried in patients who have not reached the menopause. The author applies 600 r to each of four 15-cm. portals, treating one area per day for four successive days. The menopause should be fully established about six weeks after completion of this therapy.

For controlling radiation sickness, mention is made of the barbiturates and vitamin B complex. The latter has been found effective not only in offsetting the ill effects of radiation but also in improving the general condition of the patient. Reference is also made to the possible value of pyridoxine hydrochloride (vitamin B_6) which has been found effective in controlling the nausea and vomiting of pregnancy. [For reports on the use of this preparation in radiation sickness, see papers by Van Haltern, by Oppenheim and Lih, and by Scott and Tarleton in Radiology **47:** 377, 381, and 386, October 1946.—Ed.]

Following these general considerations, the author takes up the various types of lesions to be treated, as follows:

Large Tumors of the Breast in Incurable Cases: When large masses of malignant tissue have become necrotic and are producing a foul odor, surgical resection offers quick symptomatic relief. Often, however, these large tumors will show marked shrinkage after irradiation. The multiple single-dose method through four to six sectors is quite satisfactory, but most radiologists prefer to crossfire the tumor through two or three portals, using a divided-dose tangential technic at 200 kv. Each portal may be given 2,100 to 2,400 r at the rate of 300 r per day to each area.

Involvement of the Skin: Skin metastases are almost always a bad prognostic sign. Occasionally radical treatment of a small single recurrent nodule is successful but the common surgical practice of removing one recurrence after another from the skin and subcutaneous tissues has little to commend it. The author prefers the implantation of low-intensity needles around the lesion in these cases and also in parasternal masses. In the presence of multiple nodules or cancer en cuirasse no type of treatment will cure the disease. Prolonged improvement, however, often follows the use of divided doses of x-rays generated at 200 kv. The entire anterior chest wall should be divided into 15-cm. squares, 1,800 to 2,100 r being administered to each at the rate of 300 r daily.

Metastases in the Axillary Lymph Nodes: For some reason which is not understood, cancer cells growing in lymph nodes are more resistant to irradiation therapy than the malignant cells found in the primary tumor. Axillary fat stands heavy irradiation very poorly and, although a combination of interstitial radium and a crossfire x-ray technic sometimes produces complete regression of cancer in axillary nodes, the resulting reaction is not justified in incurable cases. Implanted radium needles or radon seeds must be used with great care, so that an excessive dose will not reach the brachial plexus.

Metastases in Supraclavicular Lymph Nodes: Control of isolated supraclavicular nodes with heroic external irradiation necessitates severe damage to the skin, subcutaneous tissue, and clavicle, and for this reason the author prefers radium needle implantation. Supraclavicular nodes have remained quiescent for three to six years following this procedure. Larger areas must be treated with external irradiation, using a divided dose technic over a single portal. The skin of the base of the neck is easily damaged with x-rays and the total dose should rarely exceed 2,000 r. A rather severe reaction may be produced in the esophageal mucosa but this subsides shortly.

Skeletal Metastases: It has been known for years that relatively small doses of x-ray delivered directly to bone metastases of mammary origin often relieve pain and may produce a recalcification of the destroyed osseous structure. Striking results have been obtained by x-ray castration but no improvement has been observed following ovarian irradiation in any woman past the menopause. Relief of pain following radiation castration and 600 r delivered to each of two portals, crossfiring the bone lesion, usually begins in two or three weeks after the series is finished. Unfortunately results are not permanent but they often last one to three years. When pathologic fractures have occurred, x-ray therapy can be administered through windows cut in a plaster cast, and good union has appeared after the completion of irradiation therapy.

Brain Metastases: For intracranial metastases some neurological surgeons advocate operative removal when other parts of the body are relatively free of the disease. However, the palliative results of irradiation are usually so good that this radical procedure seems unjustified. Relief of symptoms lasting from six months to two years has been observed, and the treatment can oftentimes be successfully repeated. The author's practice is to crossfire the affected portion of the brain through two or three portals when localization is possible. In other cases, the skull is treated through four triangular ports covering the entire cranial vault. Each area receives a daily dose of 300 r and a total dose of 1,800 r, only one area being treated per day.

Spinal Cord Metastases: The symptoms of spinal cord pressure usually result from lesions growing from the vertebral bodies, but occasionally the metastases are within the neural canal. Treatment of the type used for brain metastases is frequently effective if it is applied before permanent damage occurs.

Intrathoracic Metastases: On the whole, the treatment of intrathoracic lesions with roentgen rays is un-

satisfactory. This is partially due to the fact that the patient is likely to be suffering from generalized carcinomatosis by the time intrathoracic metastases are well established. Generalized pulmonary metastases should never be irradiated because of the serious changes produced in the lungs by efficient dosage. Occasionally it seems worth while to treat a single nodule when the patient is in good condition and other metastases are not demonstrable. Moderate doses may also be directed at the mediastinum with some temporary success when pressure symptoms from enlarged nodes produce severe distress. As a rule, better palliative results are obtained when irradiation of the thorax is omitted.

Intra-Abdominal Metastases: Abdominal extension, also, indicates a generalized dissemination of the disease. Although some radiologists advocate irradiation therapy over the abdomen, particularly when the liver is enlarged, the author believes that the questionable improvement obtained in no way offsets the objectionable symptoms of irradiation sickness which invariably follow this form of treatment.

Several illustrative case histories conclude this comprehensive discussion. J. E. WHITELEATHER, M.D.

Treatment of Carcinoma of the Cervix at Charity Hospital. II. Analysis of 716 Cases. Three-Year and Five-Year End Results. Manuel Garcia and J. V. Schlosser. New Orleans M. & S. J. **98:** 314–319, January 1946.

The authors report on a series of 716 consecutive cases of carcinoma of the cervix admitted to Charity Hospital (New Orleans) during the four-year period ending March 31, 1942. Since any patient with a clinical diagnosis of carcinoma of the cervix is accepted in that institution, even when moribund, the series is entirely unselected, except that cases without histologic proof have been eliminated. It has been possible thus to assess the absolute results in accord with the rules of the Radiologic Subcommittee of the League of Nations, which lends them special significance. They represent the minimum accomplishment of treatment, including untreated, incompletely treated, and untraced patients. Actually, 96 per cent of all the cases have been traced.

The authors emphasize the point that x-ray therapy is an essential part of the treatment of carcinoma of the cervix and not an auxiliary measure to be used haphazardly. Their plan is to give x-ray therapy first, delivering a dose of 3,000 r ±15 per cent to the lateral edge of the parametria in a period of three weeks. This is followed in a few days by radium therapy—6,600 r to the paracervical region in five days (this requires an exposure of 6,500 to 8,500 mg. hours). The total duration of treatment is thirty to thirty-one days. The three-dimensional distribution of the combined irradiation then encompasses the main areas of involvement in a dosage range high enough to anticipate control of the disease in a substantial proportion of the cases.

This plan of treatment is obviously a compromise between theoretical completeness and practical possibility especially in regard to the treatment of the pelvic lymph nodes, but the authors feel that it is better to irradiate intensively the sites of frequent metastasis than to irradiate inadequately all possible areas of involvement, especially when such an attempt is associated with greater risk of immediate and late reactions. Certain modifications of the plan of treatment have to be made in some cases. In patients with severe infection, radium therapy may be impossible, and intravaginal therapy by Merritt's method has been substituted. In carcinoma of the stump and in recurrences, interstitial radium therapy must frequently be employed. In late cases x-ray therapy alone may be possible.

For tabulation of results, cases are grouped as *primary*, that is without previous treatment; *recurrent*, after treatment elsewhere; *prophylactic*, with apparently healed lesions after operation or radiotherapy. The three-year survival rate for the primary group (652 cases) is 37 per cent, for the recurrent cases (37 cases) 16 per cent, and for the prophylactic group (27 cases) 67 per cent. The rate for the entire series is 37 per cent. An analysis of the primary cases by stages shows a three-year survival rate of 82 per cent for stage 1, 50 per cent for stage 2, 31 per cent for stage 3, and 6 per cent for stage 4. The rate for white patients was somewhat higher than for colored patients, 42 as compared to 35 per cent.

Three hundred and twenty-nine patients were available for a five-year study. The five-year survival rate (without disease) for the primary cases (293) was 27 per cent, for the recurrent cases (22) 9 per cent, and for those treated prophylactically (14 cases) 43 per cent. The figure for the entire five-year group was 27 per cent.

The authors believe that the technic of treatment largely governs the proportion of primary and late reactions. Except for flare-up of infection, immediate reactions were mild and transient. Late sequels were observed in 64 primary cases (9.8 per cent). The most frequent was retrovaginal fistula, in 22 cases or 3.4 per cent. Colostomy was necessary in 14 cases, or 2.1 per cent. Most of the secondary lesions arose from renewed activity of the tumor rather than from the direct effects of radiation, although the treatment must be held responsible in the sense that it failed to control the disease and allowed the development of complications.

The most important factor which influences the outcome of treatment is the stage of the disease when first seen. The authors have not found the age of the patient to be a significant prognostic factor. The recovery rate is distinctly lower in the colored race, probably because the general life expectancy of the Negro is lower and the incidence of advanced lesions, of infection, of incomplete treatment, and of untraced cases is greater than among white patients. Septic complications at the time of treatment were found to lower the survival rate significantly. Penicillin has proved an effective aid in controlling infection.

It is shown, also, that of those patients who received 60 per cent or less of what the authors have determined as an effective dose, 32 per cent survived; of those receiving 90 to 120 per cent, 47 per cent survived, and of those receiving more than 120 per cent, 39 per cent survived. This would indicate that there is no advantage in going beyond a definitely determined minimum effective dose.

The authors believe that there is abundant evidence to prove that when the criteria for the selection of cases to be treated by radiation or by surgery are the same, the results are the same, and the permanence of healing is the same. Radiation offers less primary risk and discomfort, and under skillful management its late sequels are too infrequent to constitute a serious defect. The absolute salvage obtained by radiation is superior to that of operative interference since its greater safety and flexibility give it a much wider scope in the management of clinical material.

BERNARD S. KALAVJIAN, M.D.

A Contribution to the Technique of the Radium Treatment of Cancer of the Cervix. A New Instrument. A. M. Ritala. Acta obst. et gynec. Scandinav. **25:** 305–324, 1945.

The author describes an instrument designed to distend the vagina dorsoventrally during the radium treatment of cancer of the cervix, thus preventing the radium from touching the vaginal walls, especially the rectovaginal septum. The radium packing is kept in a stable position in the vagina against the portio, without recourse to infection-promoting tamponage. The distance in each case can be read in centimeters direct from the dilator. The vaginal radium packings are placed in lead cases, one of the walls of which (the one against the cancer) is open. The lower arm of the dilator is strengthened and prolonged with metal screens suitable for each individual case. The instrument makes it possible to administer vaginally greater radium doses to the primary tumor itself.

Thirteen photographs and drawings are included.

EFFECTS OF RADIATION

Radiation Sickness in Nagasaki. Preliminary Report. Joseph J. Timmes. U. S. Nav. M. Bull. **46:** 219–224, February 1946.

This study of the radiation effects resulting from the explosion of the atomic bomb at Nagasaki was begun approximately thirty-three days after the initial blast and was terminated two weeks later. Follow-up reports have since been obtained. Some difficulty was experienced in obtaining case histories through nonmedical interpreters, and laboratory tests had to be repeated because of differences in Japanese and U. S. standards. At first an average of 20 new patients were admitted to the improvised hospital daily, but within two weeks the admitting rate dropped sharply to one or two.

When an atomic bomb explodes, the concentrated energy is diffused in three main channels, namely, pressure, heat, and radiation, and its effects differ from the ordinary explosive bomb only in the release of radiant energy. The atomic bomb dropped on Nagasaki was exploded at an estimated altitude of 800 feet and much of the radiant energy was expended into the atmosphere.

The first concern was the amount of radiant energy remaining in the area and in the victims. X-ray film buried in the bombed area and attached to various objects about the so-called crater (a true crater does not exist) failed to reveal the presence of radioactive elements. Films attached to the limbs of atomic victims at the hospital and kept in place for eighteen hours likewise failed to reveal radiation.

The patients showed true radiation sickness, and to this the Japanese attributed most of the deaths during the first week. They failed, however, to differentiate blast and radiation victims, and they attributed to radiation many thermal burns. It can be assumed, however, that a large percentage of the early victims died from the effects of radiation. Most of the civilians were not in air-raid shelters when the bomb was dropped. Air-raid shelters with concrete walls two feet in thickness probably would have afforded adequate protection. All of the patients observed had been within 3 kilometers of the center of the explosion.

There were only a few x-ray skin burns, and these were mild in character. Many cases of alopecia were seen. Some of the victims began to lose their hair four or five days after the explosion, while in others this occurred in about the third week. None of the patients had complete loss of hair. At the end of a month a few had a new growth of a downy nature.

The principal effect of the radiation was on the bone marrow, with most of the patients showing an aplastic anemia. The blood was deficient in red blood cells and hemoglobin, but was not markedly hypochromic. A white cell count under 1,000 offered a poor prognosis; however, one patient with 400 cells per cu. mm. recovered. In some cases the white blood cells disappeared completely before death. Petechiae and gross hemorrhages were commonly seen. Bleeding times were increased and often were prolonged over forty-five minutes. Urinalysis frequently revealed albumin, casts, bile, and red blood cells.

Oral changes were common and consisted of a glossy, smooth tongue, with ulcerative lesions of the mucous membranes. The ulcers were composed of necrotic areas with a complete clinical absence of a surrounding inflammatory zone. The lesions bled easily, were often grossly infected, and showed no tendency to heal. Two cases of necrosis of the mandible and one case of noma with ulceration of the lips and necrosis of the mandible and maxilla were seen. The teeth were generally loose and easily removed by hand.

Many of the patients died as a result of terminal infection, particularly bronchopneumonia. Treatment was handicapped by limited supplies.

Protection of Photofluorographic Personnel. Russell H. Morgan and Ira Lewis. Am. J. Roentgenol. **55:** 198–202, February 1946.

With a tempered presdwood phantom producing scattered radiation equivalent to that from a subject with a chest 24 cm. thick, isodose curves were obtained for various locations around a standard 35-mm. Westinghouse photofluorograph. Readings were made with the tube operating at 100 kv. (peak), and curves are reproduced representing quantity of radiation in roentgens per 100 exposures.

The charts are applicable for other installations if the following conditions and conversion factors are considered:

(*a*) Exposure necessary for 70-mm. and 4 × 5-inch units is 25 to 50 per cent greater than for 35-mm. film.

(*b*) The use of a larger-than-average subject for the study reported gives an additional safety factor.

(*c*) Tube potentials of 90 kv. (peak) and 80 kv. (peak) increase dosage rates by 20 and 40 per cent, respectively, because of the increase in exposure time.

(*d*) Absence of a limiting cone increases the scattered radiation by an average of 30 per cent.

(*e*) Absence of a grid decreases the average dosage by 50 per cent.

(*f*) If the direct beam strikes walls of wooden or of cellulose construction, dosage increases by 50 to 100 per cent.

Observations made on protective materials show that thicknesses of aluminum and Masonite presdwood necessary for absorption equivalent to that of lead or steel make the former materials impractical. Ab-

sorption curves for lead and steel are given. It is stressed that since photofluorographic schedules often exceed 500 exposures per day, and since the amount of radiation per exposure is eighteen times greater than that for a 14 × 17 inch roentgenogram, protection of personnel must be carefully considered.

ELIZABETH A. CLARK, M.D.

Reactions of the Hemopoietic System to Agents Used in the Treatment of Dermatoses. Frances Pascher and Ben Kanee. Arch. Dermat. & Syph. **53:** 1–5, January 1946.

Repeated exposures to irradiation may be harmful to the hemopoietic tissue and may cause alterations of the normal hemogram in the form of (*a*) mild leukopenia, (*b*) neutropenia, which may develop into agranulocytosis and cause death, (*c*) aplastic anemia, (*d*) thrombopenia, (*e*) leukocytosis, and (*f*) leukemia.

Leukopenia and a drop in the erythrocyte count after intensive irradiation have been reported by various authors. The cause of the change in the blood picture has been stated to be due to direct and indirect damage to the blood-forming organs, while destruction of the circulating cells plays a minor role. Studies of the hemogram on patients receiving protracted fractional irradiation (Coutard technic) showed a leukocytosis the first few days, followed by a moderate leukopenia which returned to normal in two to four months.

Studies were made of the hemogram on 8 patients with generalized dermatosis, during the time they were receiving low-voltage radiation over large areas of the body. As a rule six fields were exposed at each treatment of 75 r each (100 kv., 1 to 3 mm. Al). Three treatments were given a week for a maximum of eight weeks. Leukopenia, which was present in all cases, began to appear after three or four weeks. The white cell count dropped to 3,000 per c.mm. or less in 3 cases, the differential count, however, remaining unchanged. In some of the cases three to five months elapsed before the white count returned to normal. A moderate hypochromic anemia was found in all cases except one, where the red cell count dropped to 2,200,000.

The authors believe that the quantitative changes in the hemogram with low-voltage irradiation are about the same as those seen when high-voltage therapy is used. Individual variations in radiosensitivity and dosage are primary factors in the development of leukopenia and anemia from low-voltage irradiation.

JOSEPH T. DANZER, M.D.

Studies on the Effects of X-Rays on Phagocytic Indices of Healthy Rabbits. A Preliminary Report. John C. Glenn, Jr. J. Immunol. **52:** 65–69, January 1946.

Further Studies on the Influence of X-Rays on the Phagocytic Indices of Healthy Rabbits. John C. Glenn, Jr. J. Immunol. **53:** 95–100, May 1946.

An investigation was undertaken to determine if x-rays, directed to a local area in a healthy rabbit, would produce any effect on the phagocytic index of the treated animal, with hemolytic *Staphylococcus aureus* as the test organism. Eighteen healthy white male rabbits, weighing from 1.7 to 3.5 kg. were selected. Blood specimens were obtained from the marginal ear veins under sterile precautions. As an anticoagulant, 0.1 ml. of 5 per cent sodium citrate in physiological saline solution was added to each 0.5 ml. of blood. All but the 2 animals which served as controls received 100 r (measured in air) over the inner surface of the left hind leg through a 6 × 6-cm. port. The legs of the rabbits were not shaved or clipped. Group I, consisting of 4 animals, was treated at 90 kv., 5 ma., 8 inch skin-target distance, and no filter (half-value layer 0.5 mm. Al); Group II (6 animals): 140 kv., 20 ma., 30 cm. skin-target distance, and 0.5 mm. Cu plus 1.0 mm. Al filter (half-value layer 0.5 mm. Cu); Group III (2 animals): 200 kv., 20 ma., 30 cm. skin-target distance, with 0.5 mm. Cu plus 1.0 mm. Al filter (half-value layer 1.10 mm. Cu); Group IV (4 animals): 400 kv., 5 ma., 80 cm. skin-target distance, with 3.0 mm. Cu filter (half-value layer of 5.2 mm. Cu). This preliminary study showed that the phagocytic indices of healthy rabbits tested with *Staphylococcus aureus* increased significantly forty-eight to ninety-six hours following radiation by 100 r (measured in air) delivered at 140 kv. over a small area of normal skin.

The optimal kilovoltage having thus been determined, further studies were carried out to find the most effective single dose of x-rays and the effect of repeating that dose at intervals. Hemolytic *Staphylococcus aureus* was again the test organism. In this investigation 35 healthy male rabbits weighing 2.0 to 5.1 kg. were used. Technics of obtaining blood and preventing coagulation were the same as in the previous experiment. The animals were divided into eleven groups to determine the effect of varying the dosage and of repeating the determined optimal dose. All treated animals received radiation generated at 140 kv. through a 6 × 6-cm. port over the inner surface of the unshaven and unclipped right hind thigh. Other factors were: 18 ma., 20 cm. target-skin distance, 4 mm. Al filter, and a half-value layer of 0.5 mm. Cu. Two rabbits were given 50 r; 4 rabbits, 80 r; 6 rabbits, 100 r; 6 rabbits, 125 r; 6 rabbits, 150 r; 4 rabbits, 200 r; 3 rabbits, 250 r; 2 rabbits, 500 r; 4 rabbits, 1,000 r. Two groups of 2 animals each received 100 r at twenty-four and forty-eight hour intervals, for a total of six and four treatments, respectively. All doses are stated as measured in air.

It was found that the phagocytic index of the healthy white rabbit can be most effectively increased by a dose of 100 r. The maximal increase occurs forty-eight hours after treatment. Repetition of the optimal dose produces an increase in the phagocytic index which is only moderately higher than that obtained with a single dose, but the index may be maintained at a high level for a short time. There is a definite tolerance of the animals to x-rays for producing an increase in the phagocytic index, beyond which point a depression occurs.

Previously irradiated animals show a return of the phagocytic index to normal at varying lengths of time following treatment, so that subsequent treatments following this event again institute a rise in the phagocytic index which is identical with that observed in untreated animals.

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